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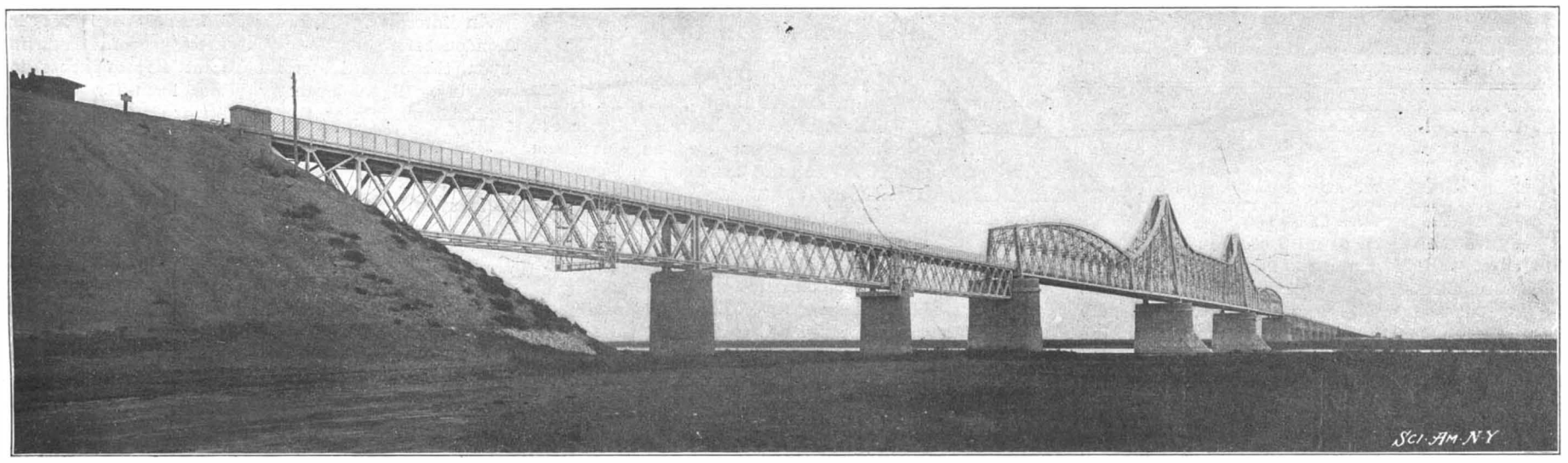
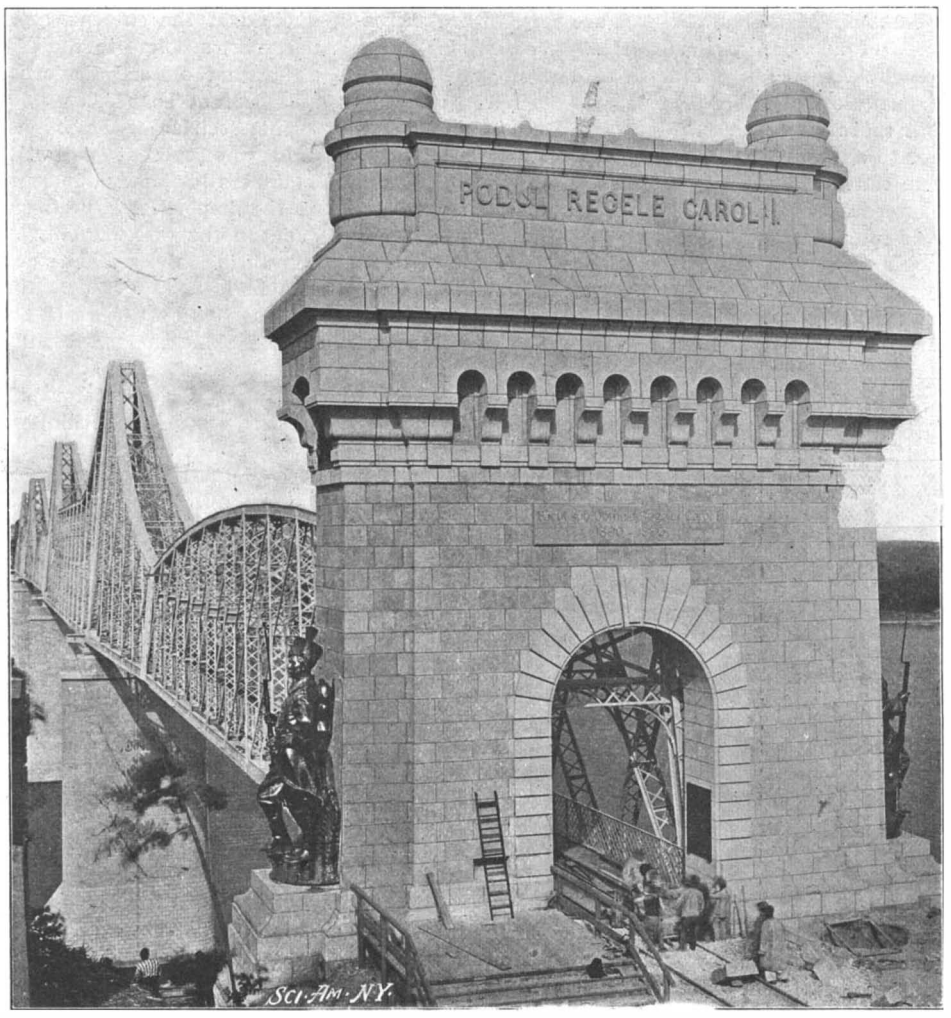
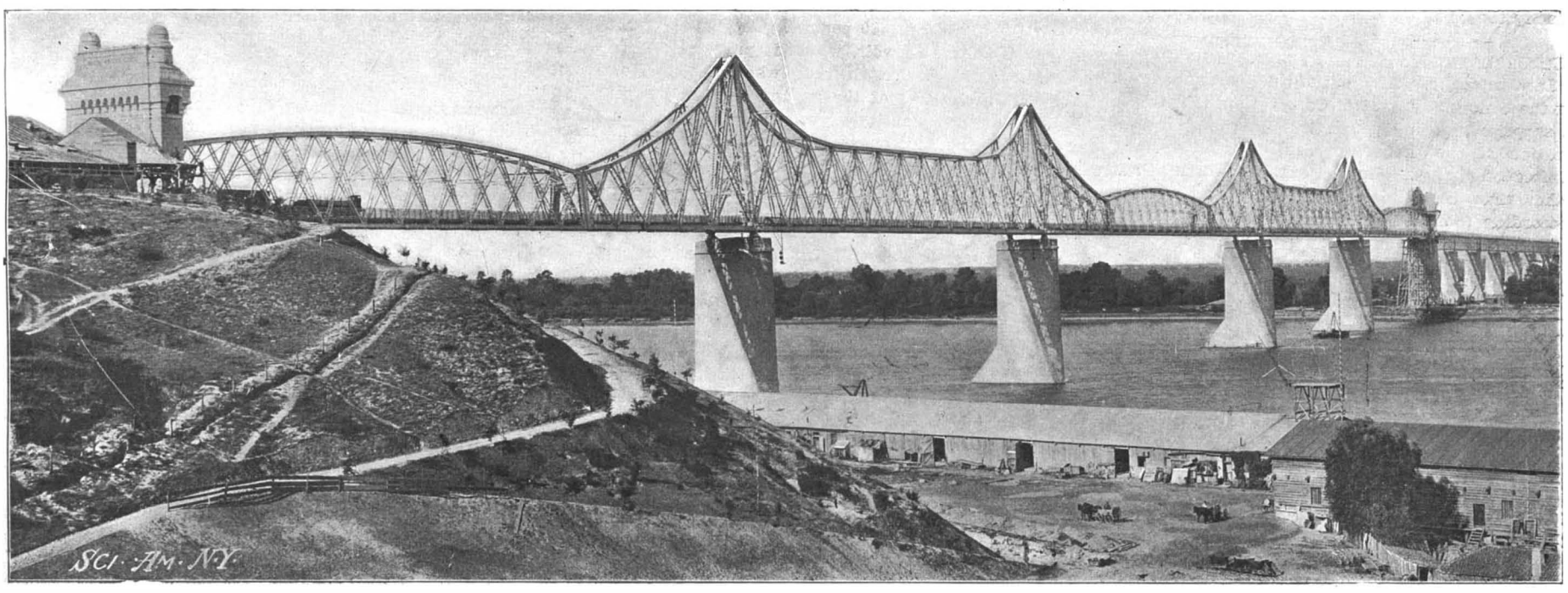


The Borcea Bridge Across Branch of Danube. Length of Bridge and Viaduct, 3,152 Feet.

Colossal Bronze Figure of Roumanian Soldier.



Monumental Portal of Charles I. Bridge.



Length of Bridge and Viaduct, 5,448 Feet

THE CHARLES I. BRIDGE OVER THE DANUBE.—[See page 272.]

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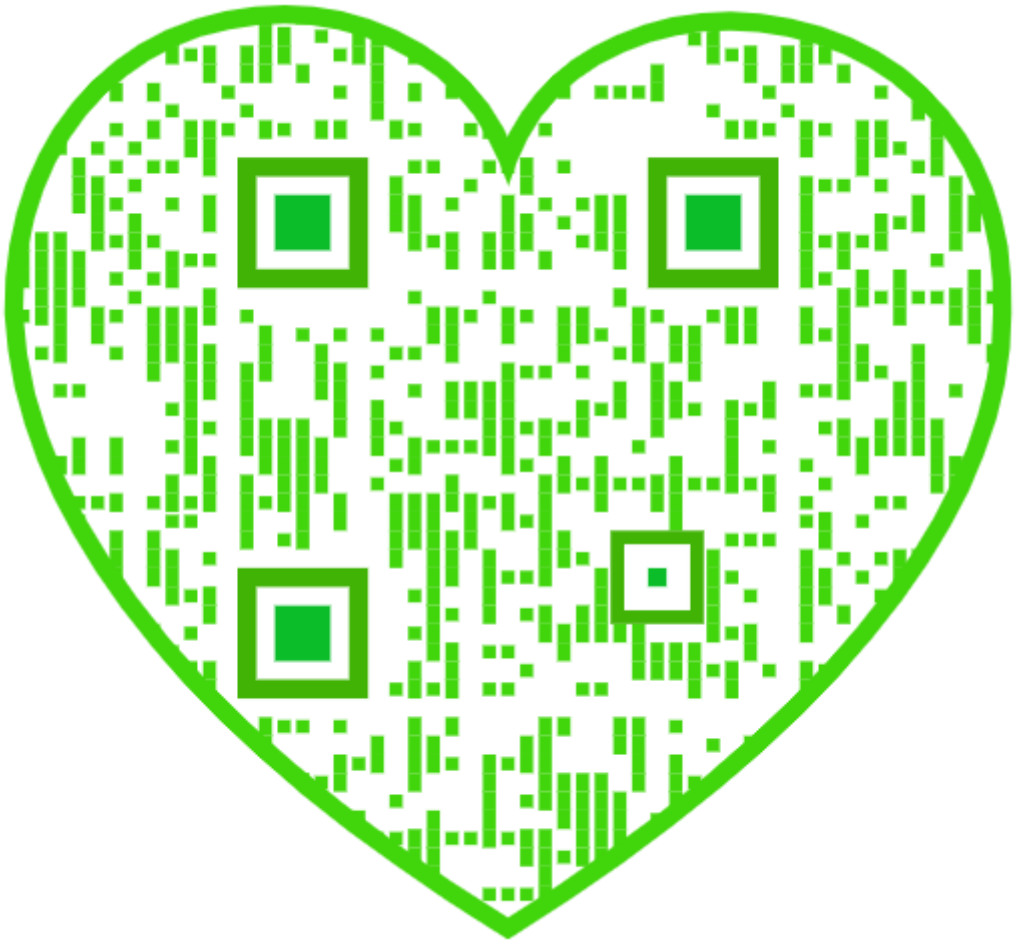

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NEW YORK, SATURDAY, OCTOBER 25, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE AFTERMATH OF THE COAL STRIKE.

The effects of the great strike in the anthracite coal regions will make themselves felt in a very practical way long after the more dramatic incidents of the strike have passed from the public mind. That the immediate pecuniary losses both to capital and labor resulting from the strike will be enormous, goes without saying; but in addition to these the anthracite coal trade will unquestionably suffer a serious loss, because of the widespread public attention which had been directed to the great question of utilizing other domestic fuel supplies than that of anthracite coal.

After all is said and done, we are very much the creatures of habit, even in America. We have used anthracite coal so long, and so exclusively, that to the majority of workaday citizens it has never occurred that there might be substitutes which would be superior to anthracite in economy, and greatly superior to it in convenience and cleanliness of use and operation. There are thousands of homes, in which, previous to the strike, the use of gas and coal oil for heating and cooking purposes was unknown, that have been driven by necessity to the use of these fuels, and have formed such a good opinion of their qualities, that they are certain to continue their use, either in whole or in part, to the prejudice of the interests of the retail coal dealer. Just how far the consumption of coal will be affected, will only be known as the winter months advance; but it is certain that the vigorous campaign of instruction which has been carried on by the gas companies and the manufacturers of coal-oil stoves and ranges, will result throughout the anthracite-using districts in a great increase in the domestic consumption of oil and gas fuel.

Elsewhere in these columns will be found a discussion of the relative merits of fuels other than anthracite coal, and in the current issue of the SUPPLEMENT we publish an illustrated article describing a number of methods of lighting and heating by alcohol, which were shown in an exposition devoted to the subject that has recently taken place in the city of Paris. While it is true that the present strike has been settled, and the supply and price of coal are likely to resume gradually their normal conditions, it is certain that the lessons of the strike will be very lasting in the public mind; and the most important of these lessons, as far as they touch the comfort of the individual householder, is that by familiarizing himself with oil and gas fuels he should make provision against the serious contingency of a coal famine as it has recently presented itself with very alarming distinctness during the past few weeks.

OUTPUT OF THE UNITED STATES STEEL CORPORATION.

In view of the vast extent of the plant and operations of the United States Steel Corporation, it will come as a surprise to many people to learn how large a proportion of the production of iron and steel of the United States is still turned out from mills and forges other than those included in the great steel trust. According to figures published by the American Iron and Steel Association, out of a total production in 1901 of 28,887,479 tons of iron ore, 43.9 per cent was produced by the United States Steel Corporation, and the balance by individual firms. From this ore there was produced 15,878,354 tons of pig iron, of which 42.9 per cent was the output of the corporation's furnaces. The total production of Bessemer and open-hearth steel ingots and castings in the same year was 13,369,611 tons, 66.3 per cent of which was produced by the United States Steel Corporation. They also produced 59.9 per cent of the steel rails, 62.2 per cent of structural shapes, 77.6 per cent of the wire rods and 50.1 per cent of a total of all rolled products of 12,349,327 tons.

It will thus be seen that the Steel Trust is far from having a monopoly of the steel trade in this country, and it is gratifying to know that this great corporation has made a wise use of its enormous influence in the steel trade, and prices have been maintained at a reasonable figure. There is no gainsaying the fact that the control of about 65 per cent of the total production of iron and steel in this country stands for a most powerful influence, should it come to the question of the control of the market, and it is sincerely to be hoped that the moderation which has marked the conduct of the affairs of the corporation will be a lasting characteristic; for herein lies the guarantee of the permanence of a prosperity in the steel and iron trade which has excited the interest and wonder of the world.

ELECTRIC EQUIPMENT OF A GREAT RAILROAD.

One of the most notable movements yet recorded in the substitution of electric for steam traction on trunk railroads is now in progress on the North-Eastern Railway, one of the most important systems in Great Britain. Special interest attaches to this work from the fact that the change is being made on a stretch of road that is not in any sense suburban, since it runs largely through an agricultural district. The change involves the electrifying of 35 miles of double-track main line, 4 miles of single-track, and 2 miles of four-track road. With the exception of a road recently constructed in Italy, this will be by far the longest stretch of electrically-operated main line in the world.

A study of the call by the North-Eastern Railway Company for bids for the construction of this work shows that the company has had the wisdom to leave a great deal to the discretion of the contractors in the matter of the plant and equipment. Alternating current will be furnished by the Newcastle-upon-Tyne Electric Supply Company, at a pressure of 6,000 volts, and this will be stepped down to 650 volts for use at the motors. The important detail of the method of reduction of the current, and other details of less importance, are left to the discretion of the contractor, although the North-Eastern Company prefers that direct current be used.

This decision of the company to leave the question of the type of current open will be commended by electric engineers in general, inasmuch as it takes cognizance of the important experimental work which is being done on the Continent in the direction of the use of alternating, high-pressure current direct at the motors. The indications are that for trunk line installations, such as this on the North-Eastern, the Ganz system or some modification of it will be found to be most efficient.

The advertisement for bids specifies that the work must be completed within twelve months from the date of signing of the contract; and if the scheme is pushed through with a vigor corresponding to the sweeping nature of the change proposed, it is likely that, before the New York Central Railroad commences the much-talked-of electrical equipping of its main lines into New York, it will have an opportunity to avail itself of the practical results achieved on this English road.

BALLOON TRIP ACROSS THE SAHARA.

In the month of December Capt. Debureaux is to commence his project of crossing the Sahara by balloon. It is intended to explore the region by a balloon containing four aeronauts, probably including Count Castillon de Saint-Victor, Jacques Balsan and Lieutenant of Marine Hourts. Before making the attempt it has been decided to carry out a preliminary experiment with a balloon of 1,300 cubic yards' capacity which is to be furnished by the Minister of the Marine. This balloon, however, will not be mounted by aeronauts; it is provided with automatic apparatus for assuring the equilibrium and for throwing out ballast at the right time, and these will take the place of the aeronauts. The equilibrium is to be obtained by a steel guide-rope measuring 2,400 to 2,700 feet long and weighing 550 to 660 pounds. The ballast arrangement is a water reservoir, which is provided with a simple automatic device so that when the balloon comes within 150 feet of the ground a valve is opened and the proper quantity of water discharged. An air-bag inside the balloon is kept inflated by an automatic air fan, and thus keeps up the form of the balloon should the gas leak out or contract under the influence of a lowering of temperature. The start will take place from Gabes, on the Mediterranean coast, about 150 miles southeast of Tunis, taking advantage of the north northwest winds which prevail constantly in the Sahara region from the beginning of October to April. These winds should drive the balloon with its guide-rope at a mean speed of 12 miles an hour. The distance to be covered, from Gabes to the Niger, is about 1,400 miles, so that the balloon should traverse this part of the Sahara in about five days. The projectors have also provided for the case where the guide-rope becomes entangled in an obstacle along the route, and for this purpose the cable possesses four points of rupture, whose resistance increases with the length of the rope, going toward the balloon. The lower sections will thus be broken first and free the balloon. Automatic registering devices will be carried, as well as carrier pigeons, which will have their cages opened by an automatic release when the car touches ground. The experiment, which is to cost about $1,600, has been favored by the government, and the Minister of the Marine, besides furnishing the balloon, will no doubt bear the expenses of the inflation which will be carried out with pure hydrogen, as well as of the transport of the material. The Municipal Council of Paris and other bodies have also given financial aid to the project. If the first experiment succeeds it will no doubt be followed by an attempt to cross the Sahara in a balloon mounted by Capt. Debureaux and the three aeronauts mentioned above.

RECENT IMPROVEMENTS IN WEAVING.

An interesting lecture was recently delivered in London before the Society of Arts by Prof. Beaumont upon the most important recent improvements in weaving. In the ordinary power loom for weaving plain simple fabrics, the difficulty for many years has been to initiate improvements which would result in greater productive power. Experiment and experience alike have demonstrated that beyond a certain speed it is undesirable to attempt economy by higher running power, which applies additional strain to the warp and augments the degree of vibration on the motive parts of the loom. If the maximum speed of a loom has been obtained on a given quality and fineness of thread, the problem arises, In what direction are further advances to be made in the construction of power looms for weaving simple types of fabrics? The builder of looms as well as the student of weaving has for some time past realized the loss of time necessitated in the recharging of the shuttle with weft yarn Other methods of conveying the weft into the warp than by the use of the flying shuttle have been attempted, but the difficulties of weft insertion have so far proved beyond solution by any more efficient means than the common shuttle.

Accepting the shuttle as the most practical weft conveyor yet devised, the modern loom builder has endeavored to provide a continuous supply of weft in two ways: First, by ejecting a spent bobbin from the shuttle and introducing a full one; and, secondly, by ejecting the shuttle containing the empty bobbin and replacing it by a shuttle with a full bobbin. The first system has been developed to such an extent by the Draper Company, of Massachusetts, that between 70,000 and 80,000 looms have been made on this principle. This invention has effected much economy in the weaving of plain fabrics. A weaver is able to mind 18 to 20 of these looms, where on the ordinary system 4 to 6 was considered the maximum. To change from one bobbin to another in a shuttle without removing from the shuttle box, and the loom running at full speed, making 190 to 200 shots per minute, is a mechanical triumph. To obtain a constant supply of weft English and Continental inventors have adopted the principle of changing the shuttle while the loom is running. Important motions for doing this are the Crossley, Hodgson and Hattersley; the two former change the shuttle while the loom is running, but in the latter the loom is for a brief period ingeniously made inoperative, and automatically re-started.

With regard to inventions applied to looms for special styles of fabrics such as velvet, swivel and lappet, two ingenious contrivances have been devised for this purpose by Mr. Hollingworth, of Dobcross, England, and Mr. Hutchins, of Worcester, Mass., respectively. In the Hollingworth device, which is for looms used in the weaving of fabrics in which wires are inserted into the warp to produce a pile effect as in carpet, velvet and plush, the reed and shuttle boxes are separated, thus providing more space for the wiring motion. The chief mechanical difficulty in such disconnection of parts—which in ordinary looms are combined—consists in securing a relative turning of the reed and shuttle boxes, so that they will be perfectly level with each other when the picking motion comes into action. Any failure of this results in the shuttle not traveling in a straight line and diverging out of its course. The Hollingworth invention is constructed in such a manner that there is little possibility of such defects arising.

The Hutchins invention relates to swivel weaving and its object is to substitute the ordinary shuttle by shuttles having a needle or pointed appearance, and in a line with, instead of at right angles to, the warp and forming one continuous series of shuttles from side to side. The chief advantage of this invention is the frequency with which the swivel shuttles may figure this fabric, there being 3 or 4 to the inch; and, secondly, in the indication of their entrance into the warp by the Jacquard, so that they be retained in or out of action for any period demanded.

In small ware looms the Poyser loom has accomplished what was, anterior to its inception, quite impossible. In this device there is a shuttle behind the reed, necessitating a division in the reed to allow the tongue or projection of the shuttle to place the thread of weft against the fell of the fabric. One advantage of this system is that the shuttle places the thread

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almost in the exact position it is to occupy in the fabric, removing the friction upon the warp yarns produced in other looms, due to the backward and forward traverse of the reed to allow of the crossing of each pick of weft. The Poyser looms are capable of running at a speed of about 390 picks per minute.

MAINE'S WOOD NOVELTY MILLS.

BY GEORGE E. WALSH.

Summer visitors to the woods find rare sights in the most unexpected places these days, and whether the trail leads along the watercourses or strikes directly across country into the very heart of the great spruce and hardwood forests, it is pretty apt to bring up to some mill where queer modern machinery is busy at work in cutting up the timber at one end and spouting out articles of commerce at the other. The great machinery chewing up forest trees of spruce to make paper for printing our books and periodicals can never quite lose its attraction to the uninitiated, and the scene of one of these modern mammoth paper mills is always a center of attraction.

But there are other mills in the Maine woods which we hear less about, and which in recent years have become remarkable institutions. We do not hear about them often, but every day of the year we use some of their products, utilizing them so often and commonly that our wonder about their manufacture ceases. These wooden novelty mills, as they might be called, are the outcome of Yankee genius in utilizing waste material by the invention of new machinery. It was found that the lumber mills of Maine were wasting enormous quantities of wood. The white pine trees furnished lumber in various sizes, but the trimmings were nearly all waste. Such immense piles of this waste wood accumulated at the various mills that it became a great inconvenience. It was difficult to burn it without setting fire to the mill, and to cart it away was both inconvenient and expensive.

Some enterprising pioneer then started in to utilize this waste lumber by manufacturing it into small commercial articles, and to-day this work has spread and multiplied so that the novelty mills are in great numbers and importance all through the Maine woods. One of the first mills established was to manufacture wooden toothpicks. A small machine was invented which would cut out of the soft pine wood hundreds of these toothpicks at one stroke. So important has the manufacture of these become that the annual output of the Maine woods to-day is over 500,000,000 toothpicks. The smallest pieces of waste wood can be used for this purpose, and the cost in raw material is practically nothing. Following these, other common articles were made at the same mill. There are a score or two of the novelty mills in Maine to-day, and their total output is enormous, including nearly all of the common articles of use. The long wooden skewers which butchers use to hold their meat together are manufactured in the mills at the rate of half a million a week. One mill alone will turn out in the summer season 5,000,000 skewers, and 50,000,000 toothpicks, besides a great number of other articles.

A common article made at these mills is the spool for cotton and thread. The spool factories number nearly a score, and they turn out something like 250,000,000 spools a year. One can hardly realize what this amount means. On them some fifty billion yards of cotton or thread can be wound. Laid in a row they would stretch across the whole State of Maine, and piled up one on another they would make a slender tower that would reach up in the air ten times higher than the tallest mountain peak. Only white birch is used by the spool factories, and they consume immense quantities of this timber. To make the annual output of spools over 15,000,000 feet of white birch timber are needed. In addition to this immense quantities of the white birch timber suitable for spool manufacturing are shipped to factories in England and Scotland.

There is a common saying that the spool factories and hoop pole hunters saved Maine's woods from being overrun by white birch saplings. At one time countless millions of deer and rabbits roamed through the Maine woods, and they subsisted largely in the spring and winter on the sprouts of the white and gray birch saplings. There is no more prolific growth than the birch, and in Maine if left unrestricted the trees will soon spread everywhere and crowd all else out of existence. The destruction of the rabbits and deer destroyed nature's nice balance, and the birch trees threatened to rule everywhere. When the trees were about to monopolize all the Maine woodlands, the hoop pole hunters and the spool manufacturers discovered that the birch was the best wood for their purposes. The result has been that an enormous industry has been built up with an inexhaustible supply of raw material, and the birch saplings have been kept within certain restricted areas.

The barrel hoops made out of the birch saplings and brown ash in Maine each year number some 35,000,000, and the demand is constantly increasing. Their manufacture cannot be said to belong to the so-called novelty mills exactly. They are made and gathered by hoop pole hunters, who go through the woods, and cut and shave them for market. The price they receive for these hoops averages $1 per thousand for the smallest size to $1.25 for the largest. A good man can cut and haul two thousand poles per day. When these are split, shaved down, and cut the right length, they will make about four thousand hoops. A man must, then, work pretty lively to make from $3 to $5 per day at this work. Some of the old hunters, however realize the latter amount during the dull season of the year when there are no summer visitors to guide or board. In the summer the hoop pole business is quiet, and few men attempt to gather the birch and ash saplings when they can make several dollars a day simply guiding people through the woods. Some two thousand men are engaged in hunting barrel hoops in the Maine woods, and the total gross income from this source is estimated between $40,000 and $50,000.

The novelty mills proper make their income from manufacturing very small things on a large scale. A bunch of wooden toothpicks, which sells in the city for a fraction of a cent must net to the manufacturers a ridiculously small sum, but when they are made and sold by the millions and billions there is money in them. Likewise the cheap wooden checkers are inexpensive articles of commerce, but in the novelty mills they pay a good profit, for one factory alone will receive an order for five million checkers. On such a scale it is possible to figure out a profit, but not unless the raw material is cheap, and the machinery invented for the work so thorough and quick that the little round pieces of wood can be made at a marvelously rapid rate. Indeed the checker pieces spout out of a funnel so fast that they quickly form a huge heap. The piece of timber is first shaved off the right size, and then as it is forced through a funnel knives cut it into small pieces just the size of the checkers.

Another product of some of the mills are small dice boxes, which are manufactured for the trade out of small pieces of timber that are discarded for building purposes. One might gather some faint idea of the gambling business in this country from the statement that some half a million of these dice boxes annually come from Maine's mills. They are shipped to all parts of the country. Backgammon, checker boards, domino boxes, and all conceivable kinds of games and boxes are made in great quantities. The same mill will have machinery for making half a dozen different kinds of novelties. There is one novelty mill in Oxford county which manufactures fifty different varieties of novelties. It is by such combinations that large profits are made. The wood which is nothing but waste after the large boxes are made is utilized for toothpicks, skewers and similar articles. In this way all the trimmings find some use.

Wooden bicycle rims are important articles of the novelty mills, and tables, desks, sleds, swings, and toys by the million swell the total output each year. Christmas toys have in recent years been made great features of the mills. This trade promises to become one of the most important. The millions of wooden toys which are sold at Christmas time can be made at the novelty mills far cheaper than in almost any other part of the world. Machinery is being made and perfected every year for cutting out toys for children, and instead of being "made in Germany," we may soon see "from the Maine woods" stamped on all our wooden toys and Noah's Arks. Recently efforts have been successfully made to paint these toys by machinery so that the cheap hand labor of Germany and Switzerland can be offset. The possibilities in this direction are very promising, and mill owners are carefully studying new methods of manufacture by machinery which will bring the cost down to the lowest figures. The supply of waste timber is almost inexhaustible, and it remains for the inventors and manufacturers to find means of utilizing it in commercial ways. So far Yankee genius has been very successful, and within a decade the output of the novelty mills may be doubled several times over.

One of the most important steps to establish aerial telegraphy stations at a distance from the coast and thus communicate with approaching ships is to be shortly carried out. The floating station will be placed in the open sea at the point 49 deg. 40 min. north latitude and 8 deg. west longitude by an English company which has been recently formed at Liverpool. This point is 110 miles west of Cape Lizard, and the station will be in constant communication with the latter point. As the distance is within the limits of good operation there is no doubt that the messages will be regularly and accurately received. The vessel which is to be anchored here will serve different purposes. It will be equipped as an electric fireship, a telegraph and postal station, a life-saving post and also as a supply station which will furnish food, coal, etc., to ships which are in need. The vessel will also be of value as representing an advance maritime post for England. There may be some difficulty in the way of anchoring such a vessel, as the ocean depth in this locality reaches 400 feet. The ship will need to be of a considerable tonnage in order to carry out the requirements, as well as to resist the force of the Atlantic during the winter season. In this exposed situation the vessel will certainly be subject to some rough treatment.

A TEXTILE NOVELTY.

BY WILLIAM VON BRENNERBERG.

The great forward strides which Germany is making, not only in the chemical and electrical industries, but in almost all technical branches, deserve the carefulest attention of American manufacturers.

The object of the following lines is to call the attention of American textile manufacturers to a new industry which has recently been started in Germany and which offers considerable prospects and possibilities, i. e., the wood-pulp or cellulose tissues made by the Patentspinnerei Actiengesellschaft at Altdamm near Stettin.

The spinning of wood-pulp or cellulose is the patented invention of Mr. Gustav Türk, manager of the cellulose works at Walsun on the Rhine, and the well-known inventor Dr. Carl Kellner, of Vienna.

The spinning process is a comparatively simple one. The fibrous materials are first treated in the usual manner, for instance in the rag engine, i. e., they are first macerated or decomposed and thereupon passed through a specially constructed machine, resembling the sieve-cylinder machine used for paper making.

The novel feature of this machine, however, is that the fibrous material suspended in water is not worked on the whole breadth of the sieve-roll so as to form a broad gauze, as is usual in paper making, but is immediately separated in strips of suitable breadth, which form a thread of rowing after being rolled up. Thus the gauze divider which was necessary hitherto is entirely avoided.

The sieve-roll of this apparatus is such that narrow strips of material acting as a sieve, such as wire gauze, alternate with strips of solid material.

In consequence of this construction of the sieve-roll, the fibrous or pulpy material adheres only to the strips of wire gauze. The continuous movement of the water in the vat contributes to remove all fibers extending beyond the edges of the wire-gauze strips, the thickness of the strips of fibrous material adhering thereto is thereby increased toward the edge, while the revolving movement of the sieve-roll tends to lay the fibers of the fibrous material in a longitudinal direction parallel to one another.

The strips formed in this manner are then taken off the sieve-roll in the usual manner by means of a band of felt and brought between pressure-rollers, where the water is squeezed out of the same. The strips of paper or fibrous material adhere to the smooth upper roller. They are then taken off this roller and passed between two sets of rubbers moving to and fro, where they are rolled up in their length.

These rowings are then passed to the fliers, where they are treated in the usual manner.

As will be seen, the process is a continuous and very simple one. In this manner fiber of only 2 to 8 millimeters length can easily be spun into yarns of considerable strength.

Another advantage of this process is the simplicity with which the dyeing can be effected.

For this purpose it is only necessary to put the dye into the vat containing the water in which the fibrous material is suspended; in this way every single fiber will be dyed before the rowing is made therefrom, and therefore the whole complicated and costly dyeing and drying process is considerably simplified.

If it is taken into consideration that the process itself is considerably cheaper than the usual method of making yarn, that even the shortest animal or vegetable fibers can thereby be easily spun into yarn, and that the price of best quality of wood-pulp is only about one-third of that of ordinary cotton, the advantages and possibilities of this process are evident.

The objection might be raised that yarn of fibrous materials of only 2 to 8 millimeters length cannot be strong or fine enough; however, this objection is futile, as there are quite a considerable number of textile fabrics where the strength and thinness of the single threads are of not so much importance as the handsome color, pliability, comparative strength and cheap price, such as carpets, draperies, furniture covers, etc. Besides, in the case of wood-pulp, the strength of the yarns can easily be increased by submitting them to a chemical treatment, and finally, if such short-fibered yarns are used as wefts in combination with cotton or linen threads as warp, every single fiber will be tied down at least three times by the warp, and therefore such tissues will be almost as strong and durable as pure cotton and linen fabrics.

Doubtless yarn made according to this process will in the future replace to a considerable extent woolen, linen, cotton and especially jute yarns, especially in the cheaper grades of tissues and for such tissues where pliability and handsome color are of main importance.

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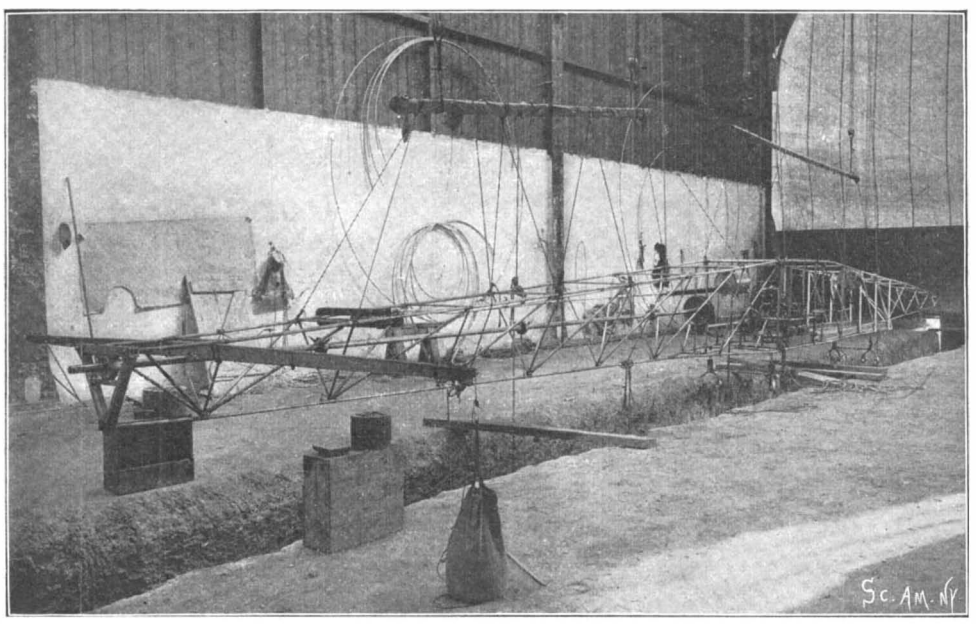
THE DE BRADSKY AIRSHIP AND THE TRAGIC END OF ITS INVENTOR.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Following hard upon the untimely death of M. Severo comes another sad aeronautical accident. The latest unfortunate is the Baron de Bradsky Laboun, who only recently completed an airship of his own design at the Lachambre establishment.

The De Bradsky airship ascended from Vaugiraud, a Parisian suburb, early on the morning of October 12, for a trial trip. After apparently satisfying himself that the contrivance was safe, De Bradsky cast off the rope which held him captive to the ground, and started southward at a height of about 350 feet. The propellers, of which there were two, seemed to work well. But the rudder seemed not as responsive as it should be. About half an hour after the ascent the balloon had returned to its starting point, and then gradually rose higher and higher until it disappeared. Later the Prefect of Police received a dispatch stating that the airship had fallen at St. Denis, 5½ miles from Paris, and that its two occupants were killed. The balloon car fell at Stain, the wire ropes connecting it with the balloon having been broken.

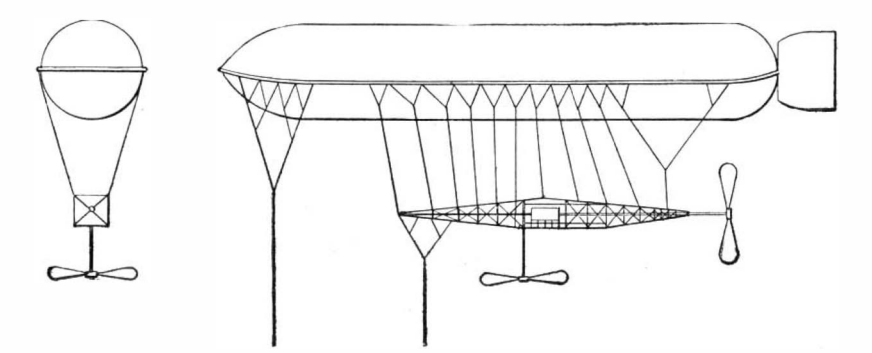


THE FRAME OF DE BRADSKY'S AIRSHIP.

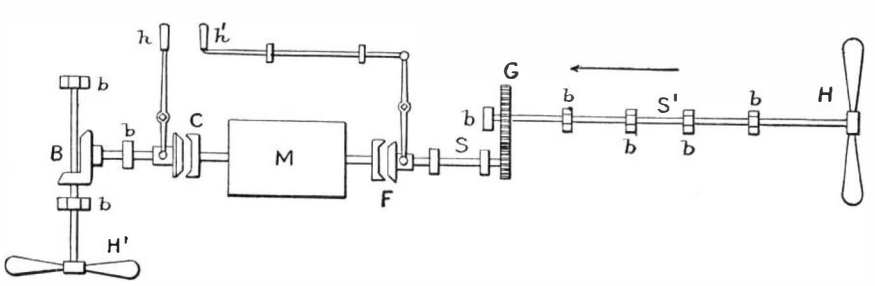
The gas-bag was constructed of light Japan silk. It had a total length of 110 feet and a capacity of 1,010 cubic yards. It was not of the usual elliptical shape, but approached more nearly the form used by Count Zeppelin, as it was mainly cylindrical, pointed at one end and round at the other. Its diameter was 21 feet. The balloon was divided into three nearly equal parts by two internal partitions, independent of each other. At the rear end was the rudder of about 3 square yards surface, made of a light steel frame covered with silk canvas. The rudder was operated by cords which passed down into the car. The supports for the car were attached to a frame of light wood which passed along the whole length of the balloon, being fixed to the canvas. To this frame were secured the piano wires that held the car to the balloon. The car or framework was suspended about 10 feet below the body. This frame was very rigid and at the same time not too heavy. De Bradsky used a light steel tube throughout. The total length of the framework, counting the propeller was 55 feet; its height about 4 feet and its greatest width the same. The motor and the aeronaut's platform were placed in the central part, which was the widest portion, and from here the frame tapered to a point at either end. The middle section was rectangular, but this became triangular in the tapered parts. The steel tubes used for the frame varied from 1 inch to ½ inch in diameter and were about 0.04 inch thick. The construction was also braced by double steel wires which were tightly stretched. At the rear end of the frame was the propeller and below the middle a horizontal ascensional screw. Both screws were composed of a steel frame and silk canvas. Their form resembled somewhat that of a bird's wing. The propeller had two blades and measured 13 feet in diameter. It revolved at 300 revolutions per minute. The ascensional screw, of similar design, was 8 feet in diameter and made 350 revolutions.

A single motor was used to drive both screws. Each of the latter had a clutch by which it was thrown on or off. The motor was placed in the center of the frame and drove the propeller by a long shaft supported by bearings. The ascensional screw was mounted on the end of a vertical shaft geared to the horizontal shaft of the motor. The diagram of the motor shows the method of transmission for both screws. At *M* was the motor, and on the right the main shaft of the motor carried the friction clutch, *F*, which was worked by a lever for throwing on the middle shaft, *S*. At *b b* were the bearings for the [illegible]. The shaft, *S*, carried at the end a pinion which engaged with a large spur gear of bronze on the end of the outer shaft, *S'*, passing to the end and supported on five bearings. The latter were ball-bearings of a type devised by the inventor in order to give an easy transmission. The bearings were supported from the corners of the triangular frame by means of piano wires provided with tighteners. On the other side of the motor was the mechanism for the lower screw. First came a friction clutch, *C*, also controlled by a handle. The shaft of the ascensional screw was connected to the horizontal shaft by a special gearing inclosed in an aluminium box, *B*. The bearings, *b b*, supported the shaft at the top and bottom of the frame. To control both screws from the platform, the handles, *h h'*, were brought together. The aeronauts' platform was next the motor and had a solid flooring of basket work. Space was provided for two aeronauts. One improvement was a long cross-arm which was placed a few feet from the propeller. The wires supporting the frame at this point were attached to the outer end of the arm instead of to the frame itself, as in the latter case they were in danger of becoming entangled in the helice.

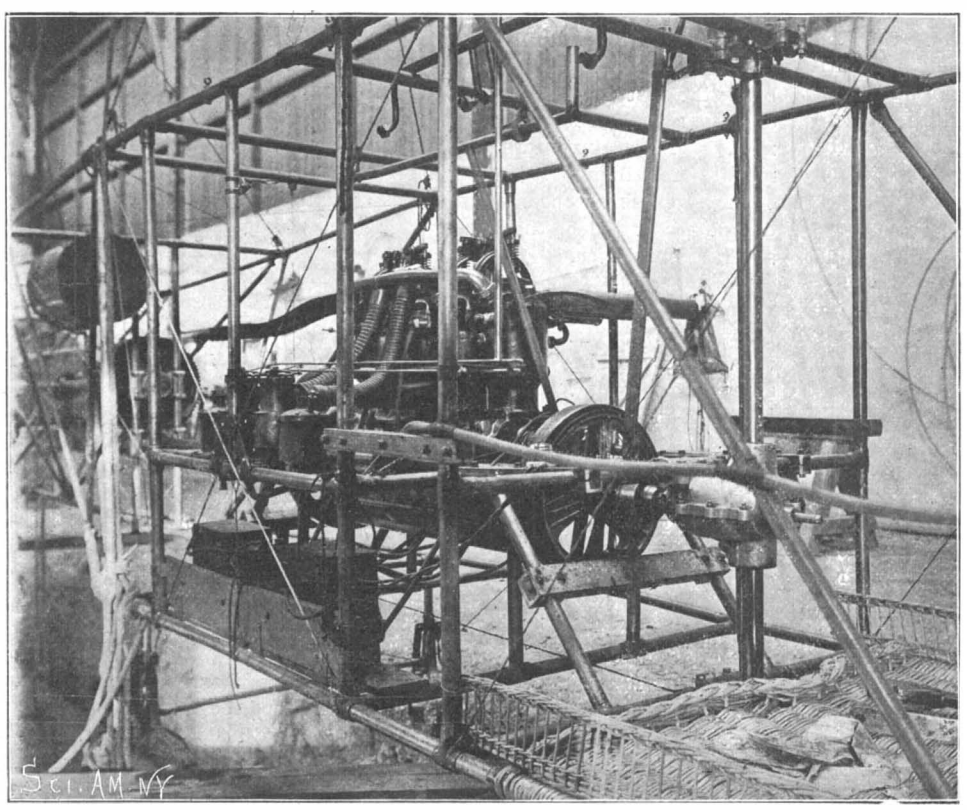
A gasoline motor of the Buchet type was used, having a capacity of 16 horse power. The motor had four cylinders, cooled by water jackets, mounted on a cylindrical crank-box in aluminium, which contained also the flywheels. The second diagram shows the disposition of the petrol motor system. Beside the motor, *M*, are the two carbureters, *C C'*, of the float and atomizer type, fed by gasoline tank, *G*, which is fixed to the upper part of the frame. At *H* is a valve with a handle and dial by which the aeronaut can vary the gasoline supply. *B* shows the position of the batteries and induction coil and *I* the spark-break of the motor. On the other side is the water-cooling system, which comprises the water tank, *W*, and the radiating tube, *T*, placed near the rear of the frame. The radiator was made especially light and the water supply reduced to a minimum. The gasoline and water reservoirs contained each about 3 gallons. One feature of great value was the arrangement for preventing sparks from the motor from reaching the balloon or igniting the hydrogen which should leak out. This was no doubt the cause of M. Severo's catastrope, and succeeding constructors will be especially careful as to this point. The exhaust gases from the cylinders escaped into muffling tubes, *M*, of sheet iron about 3 inches in diameter and 18 inches long. Each cylinder had a separate tube which had its outer end pierced with small holes. The total



DE BRADSKY'S AIRSHIP IN ELEVATION AND PLAN.



THE DRIVING MECHANISM OF THE AIRSHIP.



THE MOTOR AND MECHANISM OF DE BRADSKY'S AIRSHIP.

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weight of the car fully equipped, including the propellers, gasoline for the motor and water supply, was about 852 pounds. The airship had two guide ropes, whose position will be observed. The heavier of these was attached toward the front of the balloon, while the lighter rope was suspended from the framework.

Most of the Parisian experts agree that this aeronautical tragedy was due to De Bradsky himself. One expert claimed that the ascensional screw was at fault, the perturbing influence of which would have sufficed to paralyze both the propelling screw and the rudder, even if the motor had been strong enough to resist the light breeze from the southwest. The ascensional screw turned vertically under the car at the rate previously mentioned, and caused the airship to swing around at the rate of one turn per minute. Under these circumstances the propelling screw and rudder were powerless. From the Place de l'Opéra it was plainly visible that under the influence of this horizontal screw the axis of the balloon, obliged to turn by the resistance of the air, ceased to be parallel with the axis of the car, and in consequence the steel wires which fastened the car to the balloon were subjected to a torsional strain which they could not withstand. When the balloon was completely inflated, and the network of the steel wires completely stretched, little danger was to be anticipated. But when the balloon lost gas and its silk envelope became flabby, the steel wires from which the car was suspended were subjected to unequal strains and were easily enough twisted and broken one after another at the point at which they were fastened near the gas bag. Lachambre, the constructor of the airship, states that he had no confidence in the mechanical construction of the airship. Nevertheless, he says that the balloon had points of merit and marked a real progress in airship design. The defects were that the car was too light and that the motor and guiding screw were too weak, in Lachambre's opinion.

The army rifle competition held at Fort Sheridan, shows that the scores made this year have never been exceeded except during 1892 and 1893.

NEW YORK-BOSTON AUTOMOBILE RELIABILITY TEST.

BY THE SCIENTIFIC AMERICAN'S OFFICIAL OBSERVER.

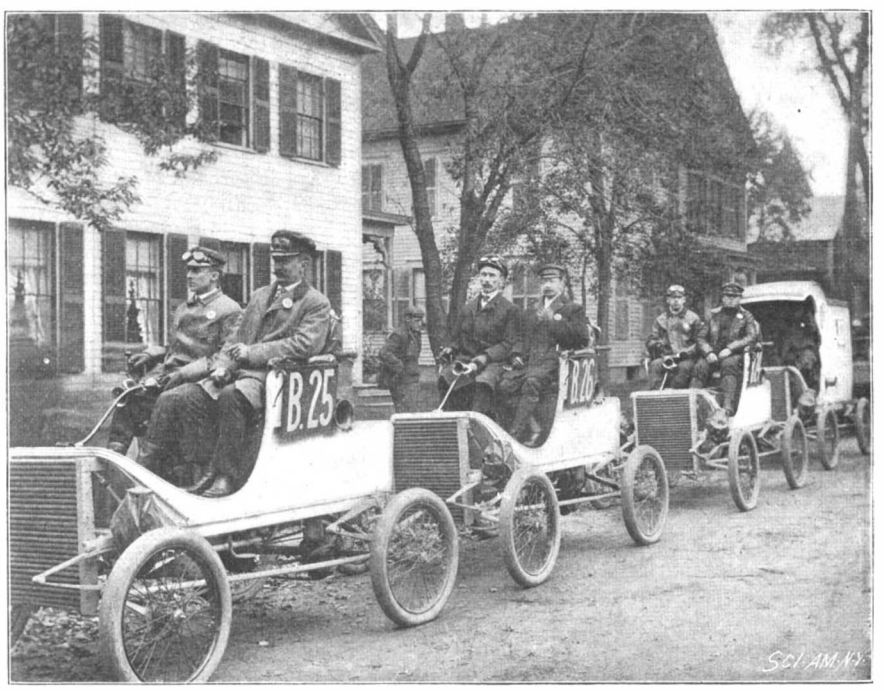
After six days of dusty traveling, sixty-eight out of seventy-five automobiles that left New York on October 9 arrived again at the starting point at 4 P. M. on Wednesday, the 15th, some twenty without having made any stops other than those on the schedule, and the rest with but one or two stops and very few breakdowns. Although the roads and weather conditions were much better than those encountered last year in the New York-Rochester test, this alone does not explain the much better showing recently made by the automobiles. In the former test, but 50 per cent of the vehicles that started finished; in the present one less than 10 per cent failed to do so. This large increase of successful contestants is the direct result of improvements in American machines.

The breakdown that occurred on the Knox machine at the beginning of the second day's run, as noted in our last issue, was repaired by the operator and observer with the aid of one local assistant, and, after six hours' delay, a second start was made from New Haven shortly after 6 P. M. Hartford, 42 miles distant, was reached in three hours, which was the schedule time; and Springfield, the terminus of the day's journey, was entered at the end of a two and one-quarter hours' run, just after midnight. The next morning at 9 o'clock this machine started with the others, and had no further stops or mishaps throughout the rest of the tour. The other two Knox cars, which were new, had no trouble whatever. The test has therefore demonstrated once more that the single-cylinder air-cooled motor of as much as 8 horse power is a success; and that larger waterless gasoline motors can be built by simply increasing the number of cylinders, is a natural deduction. Another car driven by an air-cooled motor was the Franklin, which weighs 1,125 pounds, and was equipped with a quadruple-cylinder, 8 horse power motor of the ordinary flange type. This motor also made a very creditable performance, and brought the vehicle through with but one penalized stop. It was the only other representative of the air-cooled class of motors in the test.

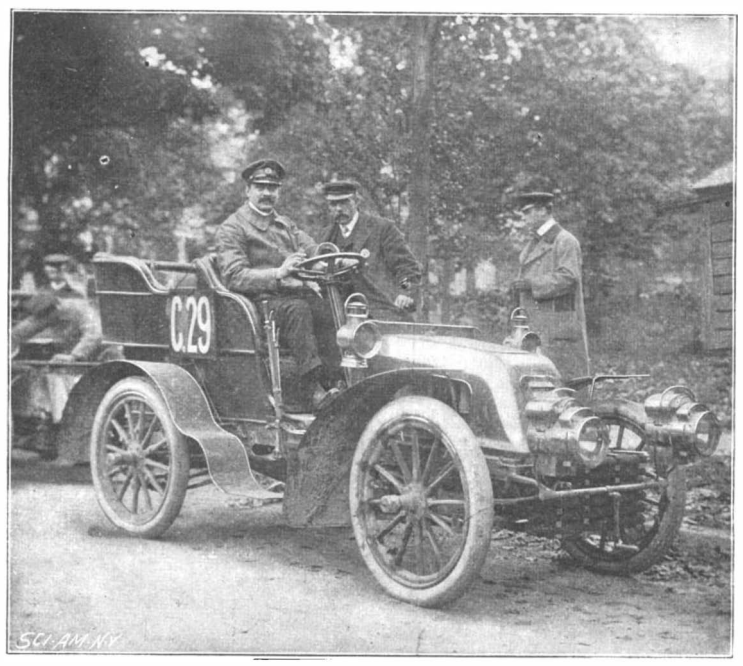
Among the new gasoline cars that had but little trouble on the journey was Mr. A. L. Riker's tonneau machine, which we illustrate. Its only accident was the breaking of four bolts in the differential gear, just after entering the Hartford control on the homeward trip. This necessitated a delay of four hours to obtain some new ones, after which the machine proceeded to New Haven without any other delays. The car behaved remarkably well for a new one. It has several novel features which we hope to illustrate later. The percentage of steam carriages that participated in the trial was quite small; but most of the machines of this type made a very creditable performance. There were five White carriages entered, four of which are believed to have made no penalized stops. These are shown in one of our illustrations. The condenser fitted on the front of each carriage gives it a radius of 150 miles with one filling of water. The advantages of the steam carriages for mounting hills were clearly shown, and their running on the level was smooth and even. The Stearns stanhope we also depict is another steam car that is said to have made a perfect score. It was about the only machine equipped with tubular steel wheels, most of the others having wheels of wire or wood.

A touring car of decided novelty is seen in the lower right-hand illustration. It is a combination gasoline-electric machine, the invention of Mr. Knight Neftel. It has a set of sixty-four storage battery cells of 75 ampere-hour capacity. This is sufficient capacity to propel the car about fifteen miles. An 8 horse-power gasoline motor coupled to a dynamo and placed in the front end of the car generates sufficient current to run the car on a level road and charge the batteries at the same time. When a hill is mounted, the battery discharges and furnishes the extra power. By employing this arrangement, a mechanical transmission is dispensed with, and an electrical car with portable charging plant is obtained. The motor is started by throwing a couple of switches, which cause the dynamo, then acting as a motor, to turn it over. The control of the car is entirely electrical, and, although the machine weighs 3,500 pounds, it can be handled with the

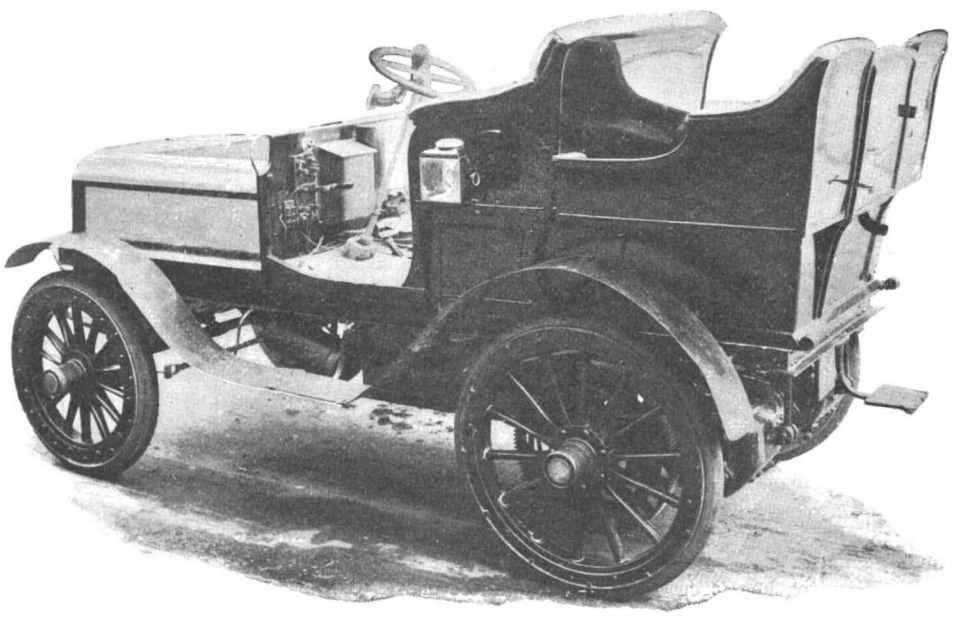
Stearns Steam Stanhope with Tubular Wheels.



White Steam Stanhopes and Delivery Wagon, Showing Condensers Arranged in Front.



The Riker Gasoline Touring Car.



The Neftel Gasoline-Electric Automobile.

THE NEW YORK-BOSTON AUTOMOBILE RELIABILITY TEST.

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greatest ease. Unfortunately it was ditched at Westport, Conn., when turning out for a wagon; and the water-cooling coils becoming damaged, together with trouble with the pump, caused the owner to drop out of the test after he reached New Haven.

The absence of electric vehicles was distinctly noticeable. None of the manufacturers tried to demonstrate the feasibility of these machines for long-distance travel, although in view of the recent statements of some of them concerning runs of 75 or 80 miles on a charge, one would expect to see some attempts made at covering this distance daily for a week, especially since an hour and a half was allowed each noon for recharging.

The tour was a most delightful one, in every way, and it showed as never before the ease with which 100 miles a day can be traveled in a modern automobile. With almost any of the present machines the chance of serious accident appears to be slight, since but few cars had a breakdown occur which could not be repaired in a short time with what local aid could be obtained.

KING CHARLES I. BRIDGE ACROSS THE DANUBE.

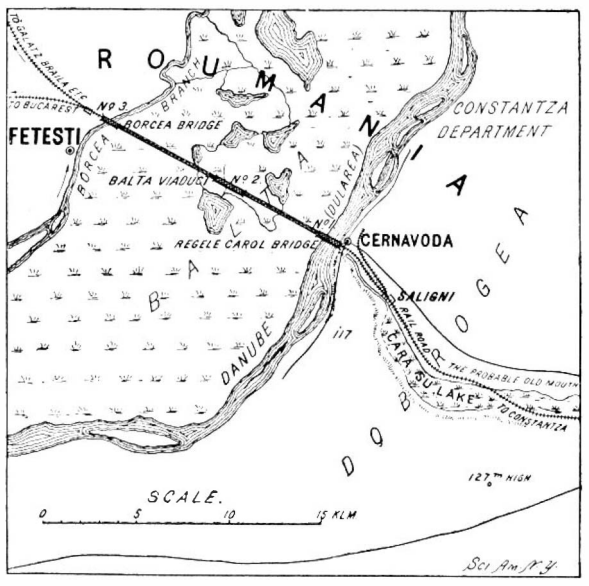
BY NICOLAE IONESCU, LIEUTENANT ROUMANIAN ROYAL NAVY.

After the great Russian-Roumanian-Turkish war of 1877-78, Roumania regained a territory which in former days she had lost, Dobrogea, lying between the Black Sea, the Danube and Bulgaria. For military and commercial reasons it was necessary to place this province in communication with the metropolis. A few years after the war Dobrogea had grown to be an important part of Roumania; its towns were greatly improved, especially Constantza, the most important town of the new province, which was destined to become a great Black Sea port. Besides its political and strategical importance, Constantza early presented itself to the Roumanian government as an excellent seaport for maritime commerce, especially during the hard winter, when the Danube was frozen and the large river ports like Galatz and Braila are inaccessible because of the dangers to which ships are exposed from the ice. It was, therefore, determined to build a railroad connecting Roumania with Constantza, a work which involved a difficult and costly crossing of the River Danube. At the inception of the work the Roumanian government instituted an international competition to secure plans for the bridge. The result was unsatisfactory and no contract was given out to any private firm, the Roumanian government deciding to have the designs executed by its own engineers. The matter was put into the hands of Mr. A. Saligny, Chief Engineer, who with the assistance of Mr. T. Baiulescu was responsible for the whole work.

The Danube at this point, as will be seen from the map, separates into two branches, the Danube and the Borcea. Between them lies a submerged island 13 kilometers in width. The main branch is only 620 meters wide and 7 meters deep, but at high water the river rises 7 meters above the ordinary level and covers the island as far as the Borcea with 2 meters of water. The current runs 2 meters a second, and the fall of water is about 18,000 cubic meters for the principal branch and 26,000 cubic meters in all. On this account the crossing involved the construction of a main bridge across the Danube, another over the Borcea, and the building of a viaduct across the island and the submerged country lying between the two branches.

In detail the crossing consisted first of the main bridge over the Danube, 748.28 meters in length, followed by 912.75 meters of viaduct, which carries the crossing to the island. Then follow 4,126 meters of embankment, 1,455 feet of viaduct, 6,086 meters of embankment and 400 meters of viaduct, which brings the crossing to the Borcea bridge. The latter has a total length of 420 meters, and from the bridge to the mainland is another short viaduct, 150 meters in length. The main crossing, the King Charles I. bridge over the Danube, as will be seen from our engraving, is an exceedingly handsome structure. It is carried on four stone piers and consists of two main cantilevers 240 meters in length and three trussed bowstring girders 90 meters in length. The depth of the girders is proportionate to the moments of the bridge, and its greatest depth, which is, of course, over the piers, is 32 meters. The webs of the girders are built up of inclined members, and the bridge is of the through type, that is, the floor is supported on the lower chords. The plane of the trusses is inclined, 1 to 10 from the vertical, after the manner followed in the construction of the great cantilever bridge over the Firth of Forth, Scotland. The width, center to center, of the trusses is 9 meters at the lower chords and 2.63 meters center to center over the piers The most interesting feature of the bridge, next to its great length, is the foundations for the King Charles I. bridge, which on account of the great depth at which rock was found, namely 31 meters below mean water level, involved some very difficult foundation work. The foundation caissons were sunk by the compressed air method. The caissons were of steel with double walls and, in spite of the abnormally high pressure under which work had to be carried on, no serious accident occurred on any of the piers, notwithstanding that there was a rise of the water level at times of 10 meters above low water mark. It will be noticed that, as in all Continental bridges, particular attention has been paid to the architectural features, and as usual with very good effect. The Cernavoda pier is the great monumental portal of the bridge. It is built of Italian granite on a massive and dignified design, and is flanked by two colossal bronze figures representing two Roumanian soldiers "Dorobanti" in commemoration of the army corps which was the first to see active service in a war which resulted in the recovery of Dobrogea by the Roumanian people. The stretch of viaduct 912.75 meters long between the Charles I. bridge and the island consists of fifteen deck trusses 60.85 meters in length, carried on stone piers. Then follow 4,126 meters of stone embankment and 1,455 feet of viaduct over the ground at Balta. These viaducts are through structures 42.80 meters in length. The next stretch of crossing consists of 6,086 meters of embankment followed by 400 meters of viaduct, the latter made up of eight deck trusses, 50 meters in length. The Borcea crossing consists of a single cantilever having a center span of 140 meters and two connecting bowstring girders 90 meters in length, the cantilever arms being each 50 feet in length, thus making three clear spans of 140 meters. The approach on the Fetesti side consists of three 50-meter spans.

In a work of this size the total quantities necessarily reached a very large figure. There are 110,207 cubic meters of masonry, while the total weight of the steel superstructure and caissons was 16,823 tons. The total cubical contents of the earth-work in the whole crossing is 2,950,000 cubic meters. The cost of the work completed was $7,000,000. The subsequent



Map Showing in Full Black Line Location of the Bridge Across the Danube and the Borcea.

results since the opening of the bridge have fully justified the confidence which led to the undertaking by the Roumanian people of this great engineering work; for Roumanian commerce has been directed to the Black Sea port of Constantza, and several new and important lines of steamships have been inaugurated with excellent results.

World's Production of Coal in 1901.

The forthcoming volume of the Mineral Resources of the United States for the calendar year 1901, United States Geological Survey, estimates the world's production of coal in 1901 at 866,165,540 short tons. The three great coal-producing countries of the world are the United States, Great Britain and Germany. The output of these three countries combined makes up 81.61 per cent of the world's total. Austria-Hungary comes fourth, France is fifth, Belgium sixth, and Russia seventh. The last country, notwithstanding its vast area, produces only about 6 per cent as much coal as the United States. The three countries which lead in the production of coal are the three countries that lead in industrial development. Prior to 1899, Great Britain led among the world's coal producers, but during 1899, 1900 and 1901 the United States has made such remarkable increases in coal production, due principally to the unprecedented activity in the iron and steel and in other metal trades, that we now stand far in the lead of all competitors, with a production in 1901 exceeding that of Great Britain by 47,965,938 short tons, or 19 per cent. Up to the close of 1900 the coal production of Great Britain and her colonies, if taken together, still exceeded that of the United States, the excess in 1900 being 3,368,825 short tons; but the enormous output of the coal mines of this country last year exceeded by about 26,000,000 short tons the entire output of Great Britain and her dependencies, including India and the Transvaal.

Of the output of coal in 1901, the United States produced 33.86 per cent, Great Britain and her dependencies 30.86 per cent, and Germany 19.42 per cent, or, combined, 84.14 per cent of the total production.

Electrical Notes.

The failure of the electric vehicle trials of the Automobile Club of Great Britain to take place, owing to lack of competitors, would seem to indicate that in the United Kingdom at least the electric automobile has retrograded during the last two years. At that time a successful test of electric vehicles was held under very adverse conditions. This year, after a committee had spent considerable time perfecting rules and classifying vehicles under the heads of town and country machines, the tests for the former of which were extremely easy, but one firm was willing to enter the contest, and so it had to be abandoned. This result is pretty much in line with what occurs in this country when a chance is given electric vehicle manufacturers to demonstrate what their vehicles can do in a well-conducted, impartial test, such as the recent reliability trials, for example. It ought to be an easy matter for a machine equipped with a battery capable of propelling it 118 miles on smooth asphalt streets, as it is claimed that one of the National Electric Vehicle Company's runabouts did recently, to cover fifty miles of country roads per charge, and keep this up twice daily for a week, yet neither this nor any other company saw fit to enter one of its carriages in the test.

The last of the main generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse Works at East Pittsburg. These generators are of the railway type (1,200 kilowatts, 650 volts, 90 revolutions per minute) and are to be direct-connected to vertical cross-compound Westinghouse-Corliss engines of 1,500 horse power each. The power house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant comprising two compound-wound generators, each having a capacity of 200 kilowatts at 650 volts, direct-connected to Westinghouse compound engines and running at a speed of 250 revolutions per minute. The power-generating plant will have an aggregate output of about 6,600 horse power—6,000 horse power for the railway proper, and 600 horse power for lighting. The Westinghouse electropneumatic system of train control is to be used, and the cars will be equipped with Westinghouse high-speed air-brakes. The rolling stock will consist of sixty cars, each about 60 feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor-cars equipped with four 100 horse power motors each.

In demonstrating the ionic charges of the atmosphere, H. Ebert describes some simple and instructive experiments. A plate of tinned iron two square meters in area is supported four meters above the earth's surface on insulating pillars planted on the top of a slope seventy meters high overlooking the River Isar. In clear weather the plate was first connected to earth acquiring a negative charge, then being disconnected and left to itself for some time so as to acquire the potential of the surrounding air. It was then earthed through a galvanometer, and showed a current proceeding from the plate to the earth. The charges acquired vary within wide limits by the weather, being largest in fine and smallest in foggy or damp weather. This shows that the connection of negative ions from the atmosphere of the earth varies in accordance with their mobility in the atmosphere. A rough estimate of the quantity of electricity thus conveyed on a fine day gives about 300,000 electrostatic units per square kilometer per minute.—Physikalische Zeitschrift.

Wireless Telegraphy for Yachtsmen.

The Marconi Wireless Telegraph Company of America has secured a site for a station at Eaton's Neck, Long Island, where a station will be installed, the first of a series along the Sound, and the territory adjacent to it, which will be operated for the convenience of yachtsmen. While the service will not begin until next season, several of the best known yachtsmen in America, who are identified with vast business interests, have already made arrangements to have their craft equipped with Marconi apparatus. The Sound service and the stations on the ocean side at Cape Cod, Sagaponack and Babylon will make it possible for yacht owners cruising in these waters to keep in communication with New York whenever necessary.

Reconstruction of the "Philadelphia."

The "Philadelphia," one of the original "White Squadron," is being remodeled at the Puget Sound navy yard. The vessel is to be completely re-equipped in every respect. When she is launched again she will be a vessel of which the navy may be justly proud. At least a year and a half, or perhaps two years, will be required to remodel her completely.

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Engineering Notes.

The Baltimore & Ohio Railroad Company has built four miles of line in Pennsylvania, which is believed to be the crookedest railroad in the United States. This little road will extend from Boswell, Pa., to Friedens on the Somerset & Cambria branch of the Baltimore & Ohio. The air-line distance is about five miles, but the peculiar conformation of the country makes it necessary to loop a number of hills in order to get an easy grade. The new road doubles on itself four times, and at one point, after making a loop of about five miles, the road comes back to within 300 feet of itself on a grade 50 feet lower.

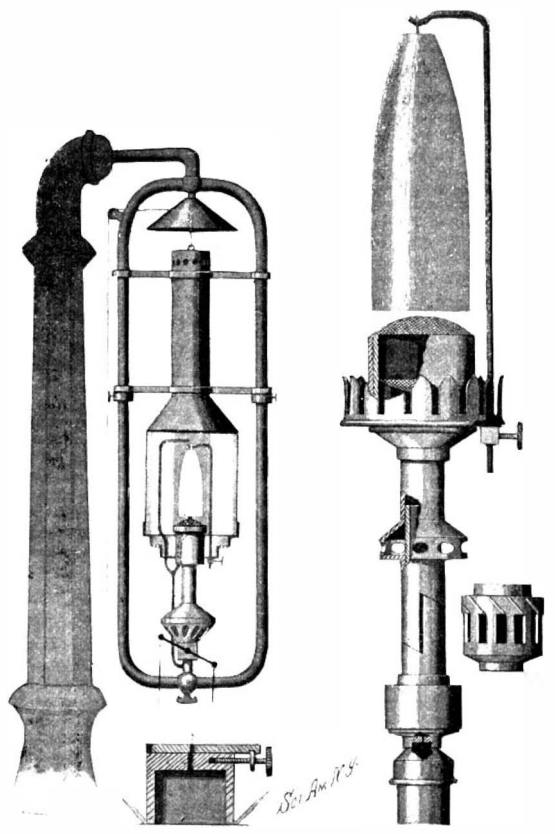
The southern press dilates upon a new plow, the invention of which is accredited to Dr. Gatling, famous for the gun that bears his name. Dr. Gatling has devised a motor plow driven by a gasoline engine. The truck is said to be constructed like the trucks of traction engines, except that the steam boiler is displaced by a strong platform on which is mounted the motor connected with the traction gearing. A set of disk plows is attached to this truck, and these plows can be made to run at any depth or any angle required. It is estimated that with this machine one man can plow from thirty to thirty-five acres in one day.

The city of Bahia, which is situated on the coast of Brazil, South America, has a population of about 200,000 inhabitants who are housed in 17,000 dwellings. The water supply for these people has been furnished by a local company ever since 1852. It is brought from the nearby mountains, and thus far the expenditure for the works, including the pipe system, fire plugs, etc., has amounted to $1,500,000. According to the Municipal Journal and Engineer, the supply is not adequate to the needs of the city, and for a long time negotiations have been going on between the company and the city for the purpose of increasing the supply. The monopoly has been renewed for a period of forty-five years and some valuable franchises and privileges have been awarded the company. On the expiration of this contract the city will have the option to buy the company's plant at the valuation of expert engineers. Every dwelling in Bahia must use water, and the municipal officials of the city regulate the price. For the average dwelling for 422 quarts a day, ten cents is charged; twenty-one quarts of water is furnished to the public fountains and hydrants, at a low price. The improvements contemplated by the company will cost in the neighborhood of $600,000, but owing to the financial crisis prevailing in Brazil, the company has been unable to obtain the money required to complete the water system and therefore desires to sell its plant and privileges. The price asked is $1,100,000. It is estimated that the earning power of the water works, when completed in accordance with the new contract, will be $300,000 a year, and the company purchasing its rights will doubtless be awarded a contract for establishing a drainage system in the city and for furnishing the houses with sanitary plumbing.

One of the original locomotives, writes a correspondent of the London Railway News, built by George Stephenson in 1822 for the opening of the line of the Hetton Colliery, near Durham (England), between their works, a few miles northwest of Durham, and the shipping staiths on the Wear at Sunderland, is still employed hauling the trucks at Hetton, and is now, after eighty years' continuous service, claimed to be the "oldest working locomotive in the world." The principal dimensions of this "old-timer" are: Diameter of the cylinders, 10¾ inches; piston stroke, 24 inches; diameter of the wheels, 3 feet. The weight of the engine is 15 tons, and it has a haulage capacity of about 129 tons at a speed of 10 miles an hour on a fairly level track. Its general design (excepting the cab) remains as originally constructed, while some parts, notably the steam dome, are actually portions of the engine as constructed in 1822. After this long and faithful service, it is not surprising to learn that the engine is at last becoming unequal to the ever-increasing demands made upon it, and the directors of the Hetton Colliery, therefore, and with commendable appropriateness, shortly intend to withdraw the relic from Hetton, and it will in the course of a few weeks find a permanent resting-place at the Durham College of Science, Newcastle-on-Tyne, where it will be preserved to this and future generations as a worthy example of the earliest period of locomotive engineering. It may be noted here that Stephenson's "No. 1 Locomotion," built for the opening of the Stockton and Darlington Railroad in 1825, continued in working on "the first public railway" until 1850, when it passed into the hands of Messrs. Pease & Partners, by whom it was used for colliery purposes until 1857, at which time it was placed on a pedestal for exhibition at Darlington Station, where it is to be seen to-day, so that not only in point of date of construction, but also as regards years of "active service," must the engine used at the opening of the first public railway give place to that constructed for the Hetton line by George Stephenson fourscore years ago.

TWO NEW INCANDESCENT GAS BURNERS.

Two important improvements in incandescent gas burners are herewith illustrated. The burners are designed to insure a perfect mixture of the air and gas and at the same time use but a minimum of gas in the mixture. The arrangement causes a proper burning of the mixture, producing a complete and brilliant incandescence of the mantle and hence a light of great strength, brilliancy and softness. The burner shown at the right is adapted for ordinary use in rooms of limited size; that on the left is intended for street lighting or the illumination of halls, large rooms and the like. The former type is adapted to be placed upon the tip of an ordinary gas supply pipe. The supply pipe is covered by a cap having a small outlet opening which admits gas into the mixing chamber just above. This chamber is provided with apertures in its side wall, as shown in the small detailed view. A nut having an internal thread is adapted to be screwed down over these apertures. By adjusting this nut the apertures may be more or less uncovered to admit more or less air into the mixing chamber. A tube extends upward from this chamber, and is surrounded near its upper end by an annular chamber having large inlet openings to admit the air. On the bottom of this chamber is a sleeve extending downward over the tube referred to, and provided with a spiral engaging a corresponding spiral on the tube, so that by turning the sleeve the annular chamber is raised past the upper end of the tube and more or less air is admitted thereto. From the top of the chamber a conducting pipe extends to the main mixing chamber. This is provided with two wire screens spaced a



NEW INCANDESCENT BURNERS.

suitable distance apart. The gas and air in passing through the fine meshes of these screens become thoroughly mixed, forming an easily combustible mixture which, when ignited, renders the mantle incandescent and produces a powerful light that combines brilliancy with softness. Since so small an amount of gas is admitted into the burner, it is evident that great economy of gas is had.

The second type of incandescent burner, which is illustrated on the left, embodies certain novel features by which it is adapted to produce a much more powerful light. The gas supply is connected to a service pipe, preferably made in the shape of an elongated loop. A feed pipe extends upward from the bottom of this loop, and enters a mixing chamber. Mounted on the top of the feed pipe is a slide-valve controlled by a thumb screw, as shown in the small detail. An inlet port in the mixing chamber is formed by a small opening in the top of the feed pipe, which registers with a similar opening in the slide-valve. By moving this valve inward or outward, the inlet port is more or less closed, and thus the flow of gas may be regulated to a nicety. The mixing chamber is provided with openings for the admission of air which thoroughly mixes with the gas in passing up the long conducting tube to the burner. The burner is provided with a screen of fine mesh which minutely divides the mixture and prepares it to be properly burnt in the mantle. The chimney carrier is provided with openings which admit air to the outer surface of the mantle, thus insuring high incandescence. A tube with a flaring bottom rests upon the top of the chimney and is provided with lugs mounted to slide on the side arms of the service pipe. The tube is provided with openings at the top to permit the escape of the products of combustion. The purpose of the tube is to create a draft and cause the air and gas to be forced up under additional pressure, thus affording a brilliant light. When it is desired to remove the chimney, this tube may be raised out of the way by pulling the cord or chain fastened thereto, which passes up over a pair of pulleys and hangs down within easy reach.

Just below the mixing chamber is a valve carrying on the valve-stem the usual lever, from the ends of which the operating chains depend. From a point immediately below this valve a pilot pipe leads upward and projects through the screen at the top of the burner. A branch from this pipe extends upward to the top of the mantle. By this means when the valve is closed, two small flames continue to be fed by the pilot pipes, and when the valve is again opened the gaseous mixture is again ignited by these flames, both from the top and bottom of the mantle. The pilot pipe is made in two sections which are joined together by a coupling within the mixing chamber. By this arrangement the parts may be readily disconnected to give access to the regulating valve in the mixing chamber.

Patents on these improved burners have recently been granted to Mr. James Buchanan, of 203 Broadway, New York.

The Finding of the Revolutionary Prison Ship "Jersey."

In building a section of the new ways for the construction of the battleship "Connecticut" at the Brooklyn navy yard, the famous English prison ship "Jersey" was discovered. She was one of six prison ships used during the Revolution. Probably built somewhere around the year 1720, she saw some thirty years of service, fought many a battle and was then condemned to be used as a receiving vessel for American prisoners of war.

Of the six prison ships, the "Jersey" was by far the worst. She was a kind of floating Black Hole of Calcutta, and in her damp, leaky hold half-starved American patriots perished miserably. In her palmy days the "Jersey" had a crew of about 400 men, huddled together as crews were in those days. How appalling were the conditions to which American prisoners were subjected may be gathered from the fact that 1,200 prisoners were kept on board almost constantly. One historian says: "She was never cleansed, and lay in that condition seven years. No fires warmed her occupants in winter, no screen sheltered them from the August sun, no physician visited the sick, no clergyman consoled the dying there. She remained throughout the contest a center of sickness and death, always replenished with new victims. The bones of her dead, estimated at 11,000, lie buried on the Brooklyn shore." When the war ended, the "Jersey" was burned at her moorings.

For years historical societies and government officials have tried to locate the ship. The half-burned hull lies in about two fathoms of mud and water about 500 feet from the dock. Unless the hull is removed the battleship "Connecticut" must be built directly over it. Whether the hulk will be raised seems doubtful. About $500 would be required, and the delay in the construction of the battleship would be considerable. The ways are already behind time as it is.

Interest in the old ship reached its height when, some years ago, the skeletons of 300 men were found in the yard. That these were the remains of the men who had died in the "Jersey" was definitely established. The bones were afterward buried in Fort Greene Park with impressive ceremonies.

The Current Supplement.

The current SUPPLEMENT, No. 1399, contains a wide range of interesting articles. The first article deals with a novel block signaling system in which electric semaphores are used. Mr. S. D. Mott explains a novel plan of mechanical aerial flight or air suspension based on well-known ascertained facts. The machine for this purpose he terms an "aerodrome." For manufacturers and exporters an explanation of the business opportunities in Portuguese colonies should be valuable. The coal strike has brought home to the dwellers of large cities the need of some device whereby it is possible to burn soft coal without smoke. Therefore an article on a locomotive stoker which has been successfully used on railways should prove of interest. The value of alcohol as a fuel has been more than once commented upon in these columns. A further discussion of the subject will be found in the current SUPPLEMENT, the occasion for which is the International Alcohol Exposition of Lighting and Heating Apparatus, recently held in Paris.

Mr. Frank H. Mason, our Consul-General at Berlin, tells much of the German processes and machinery for briquette manufacture. Dr. Peter T. Austen concludes his paper on the "Chemical Factor in Human Progress." The usual Trade Suggestions from the United States Consuls as well as Trade Notes and Recipes are also published.

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THE ROWLAND MULTIPLEX SYSTEM OF PAGE-PRINTING TELEGRAPHY.

To the constantly-increasing list of page-printing telegraphs must now be added that of the late Prof. Henry A. Rowland, one of America's most brilliant physicists. The invention is based upon new electro-physical principles, and for that reason merits the consideration of scientific telegraph engineers.

In the Rowland system an alternating current is employed which is altered in a number of different ways, any one of which is used for sending signals over a line. In Fig. 1 an alternating current is diagrammatically shown, which has had certain of its waves modified in six different ways. The minus half-wave 2 at *E* has been reversed; minus half-wave 4 at *A* has been cut out; the positive half-wave at *B* has been cut out; the two half-waves at *C* and *D* have been increased in height; and at *F* a positive half-wave has been turned into a negative half-wave. If the alternating current were traced on a chemical treated paper, these modifications of its half-waves could be interpreted as six different signals. In the Rowland system, such cut-out positive and negative half-waves are employed. A signal, however, is made to consist of a pair of cut-out half-waves which are not adjacent. It, therefore, happens that wave groups can be formed, which are a very important feature of the invention. The half-waves can be divided into groups, *A*, *B*, *C*, *D* and *X*, leaving an extra half-wave between each group. If out of each group two or more of its half-waves be cut, a signal can be made to consist, not of one cutout half-wave, but of a combination of half-waves cut out from a group. For example, if the half waves 1 and 3 are cut out from group *A*, this could be interpreted to mean one thing; while if the half-waves 1 and 4 were cut out, this combination would mean another thing. In practice the signals are made up by cutting out any two half-waves not adjacent. From a group of 11 half-waves, it is possible to obtain a total of 45 different signals, any one of which can be sent over the line during a time in which the current makes 11 alternations. The system in practice makes use of five groups of waves with one extra half-wave between each group.

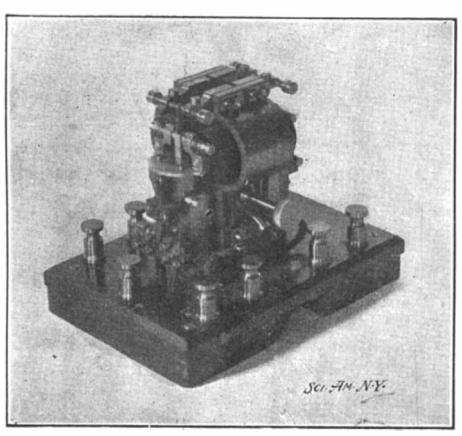
Prof. Rowland found that he could employ profitably about 208 alternations of the current per second. Hence, 52 half-waves, illustrated in Fig. 2, will pass over the line in one-quarter of a second; or in other words, any group of waves will be repeated four times each second. Thus four operators utilizing the groups, *A*, *B*, *C*, and *D*, can send four different signals each quarter of a second. Hence 960 different signals can be transmitted over the line in one direction in one minute, following one another so rapidly that the four different operators apparently send their signals simultaneously. It follows that the system is, therefore, a multiplex system. Its total capacity for one wire is four different signals each way in one-quarter of a second. Or in other words, 1,920 signals can pass over the line in a single minute. Professor Rowland developed his system so that numerals, letters of the alphabet, and some extra signs are automatically printed in such a manner that each operator by writing on an ordinary Remington keyboard prints at the end of the line on a page eight inches wide. The pages of printed matter have the general appearance of an ordinary sheet of typewritten matter. Forty words per minute is an ordinary speed for a practised operator, so that altogether eight operators can print over an ordinary telegraph line at the rate of 320 words per minute.

As in all systems of telegraphy, it is essential that certain parts of the rotating mechanism at each end of the line shall operate in unison. At first sight it might seem that since an alternating current is employed in the Rowland system, synchronism could be easily secured simply by passing the current through a small single-phase motor. But experience has shown that this is not sufficient on account of a phenomenon which engineers call the "pumping" of two machines which otherwise run synchronously. This "pumping" must be entirely eliminated. By employing a device called a mechanical "damper," Prof. Rowland succeeded in securing wonderfully perfect synchronism. Fig. 3 shows the method which he employed. Fixed to the shaft, *S*, of a single-phase alternating-current motor of small size is an aluminium wheel, *A*, in which is cut a small channel, *C*, filled with mercury. If the speed of the rapidly-revolving shaft and its wheel be subjected to oscillating increase and decrease, the mercury, on the other hand, will tend by its inertia to revolve at a uniform velocity. A friction is, therefore, produced between the mercury and the walls of the aluminium channel when their speeds are unlike. The oscillation or "pumping" is thereby dampened, and the rotation of the shaft becomes smooth and uniform. The device is simple but effective. Without it perfect synchronism would be impossible.

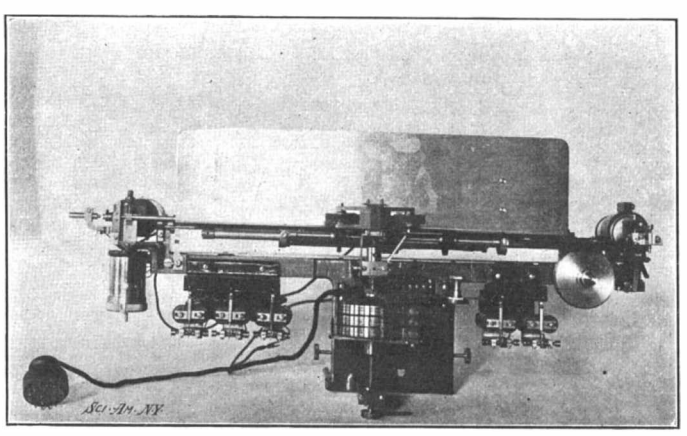
The synchronizer itself consists of a small alternating single-phase, four-pole motor of special design. The armature is made of four flat coils without iron and has a diameter of about three inches. Synchronism is maintained by local currents. The line current of from 30 to 70 milliamperes has only one function to perform, and that is to keep the two tongues of a polarized relay of a special design in constant vibration. In a novel method of making contacts one of these tongues is made to complete the local circuits which print the characters, while the other tongues serve to send positive and negative local currents through the coils of the synchronizer in a manner to preserve the synchronism.

The operation of cutting out the waves for transmitting the cutout wave signals over the line is performed on ordinary Remington keyboards, so constructed that the keys can be depressed only at intervals corresponding with the passage of 52 waves over the line, or at intervals of about one-quarter of a second. The locking device which times the depression of the keys is called the "clapper," and unlocks the keys four times per second, that is, each operator can cut out four different special combinations, and so send four different signals over the line in one second. Each of the four keyboards can cut out only waves of the group which is assigned to it. The manner in which this is done can best be explained by reference to Fig. 4. The four keyboards are represented by K_1, K_2, K_3, K_4. Each keyboard is supplied with eleven insulated contact springs 1, 2, 3, etc. To the frame of each keyboard is attached the negative terminal of a direct current 110-volt circuit. When any one of the 41 keys, belonging to a keyboard, is depressed, contact is made with some two of the 11 contact springs. The contacts made will be the combination which corresponds to the letter marked on the key. *C* is a so-called commutator or "sunflower." It is similar in construction to the commutator of a small dynamo and has 52 segments insulated from one another. There are four sets of segments, which are connected respectively to the eleven contact springs of the keyboards, K_1, K_2, K_3, K_4. The remaining eight segments are some of them entirely insulated, while others are connected to devices for cutting out waves used for automatic signals, but which are not shown in the diagram. In other words, the segments are divided up so as to correspond with the groups of half-waves shown in Fig. 2. The group *A* is connected to the contact springs of keyboard K_1, the group *B* to the contact springs of keyboard K_2, etc. Corresponding to the half-waves between the groups, *A*, *B*, *C*, etc., there are insulated segments which are shown in cross-section in the diagram. A brush or trailer, *t*, travels around the commutator *C* in synchronism with the dynamo *Da*, being geared to its shaft. This trailer passes from the center of one segment to the center of the next, while the current from the dynamo *Da*, makes half a wave. When the brush is at the middle point of a segment, the current from the dynamo is supposed to be passing through zero value.

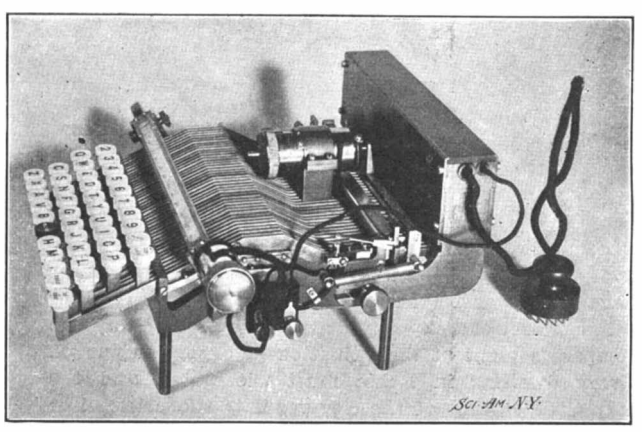
If the key be now depressed on keyboard, K_1, contact with the frame of this keyboard will be made with two of the contact springs, as, say, 7 and 11. When the trailer, sweeping around the commutator, reaches segment 11, which is connected to contact spring 11, the current from the 110-volt circuit flows momentarily from the positive pole through the coil, *C*, of transmitter, *Ta*, to the trailer, *t*; from there to the segment 11, thence to the contact spring 11, to the frame of the keyboard and back to the negative terminal. This current causes the transmitter, *Ta*, to draw back its armature, *A*, and thus break the dynamo circuit at *P* which goes to the relay and line, and at the same time the line is connected at *N*, to earth. Immediately, when the trailer passes off from segment 11 the spring



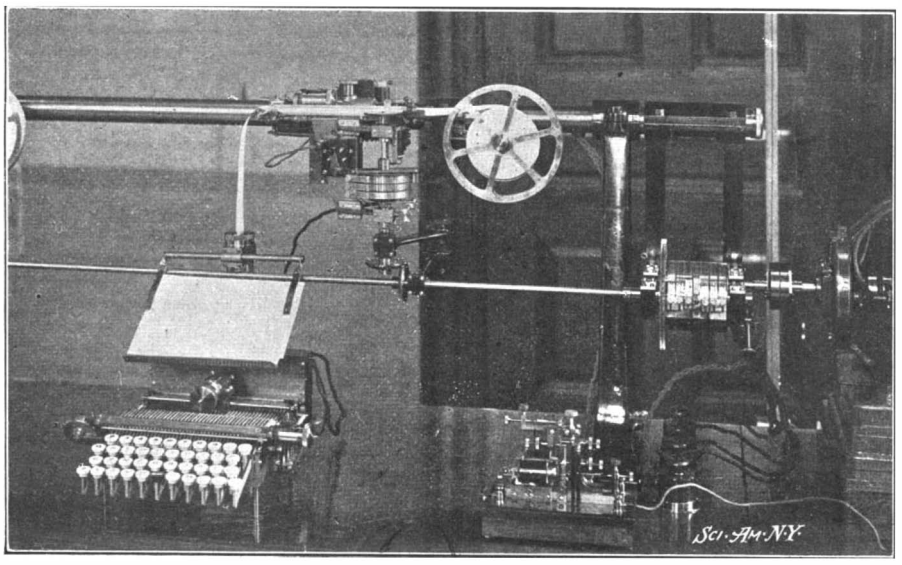
Main Line Relay.



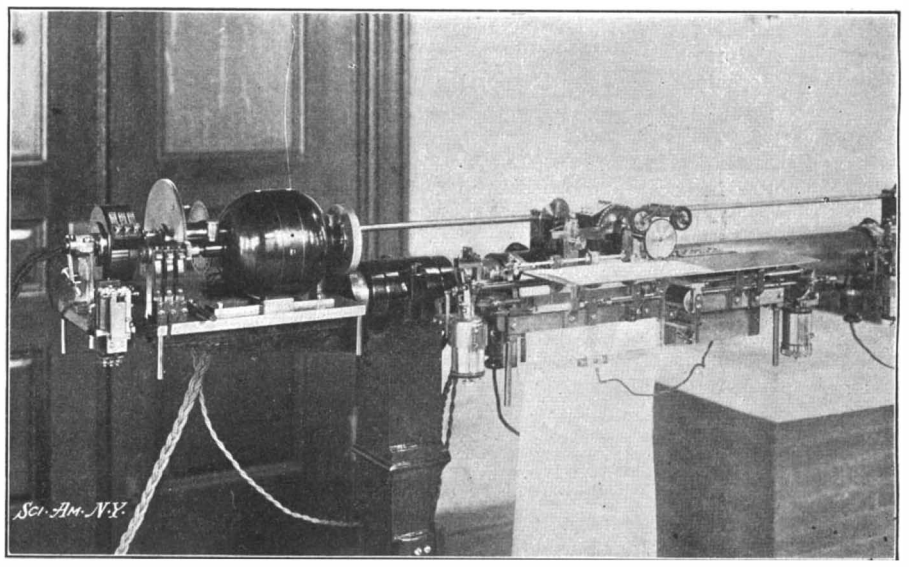
Printer, Showing Combination Commutator and Distributing Relays.



A Transmitting Keyboard.



Keyboard, Home Recorder, Transmitter (Main Line) and Sending Commutator.



Synchronizer, Receiving Commutator, and One Printer.

THE ROWLAND MULTIPLEX PAGE-PRINTING TELEGRAPH.

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S_1, pulls the armature A back, completing the line circuit with the dynamo, D. Thus, a half-wave of group A (see Fig. 2) has been cut out of the line circuit. When the trailer arrives at segment 7, the same operation is repeated, because the contacts which are made at the keyboard continue for a period equal at least to the time that the trailer takes to pass over the 11 segments which are connected to that keyboard. In like manner the operators on keyboards K_2, K_3, K_4 can cut out, by depressing some one key, any two waves from the groups of eleven which belong to them. An insulated segment is placed between each two groups of eleven waves, so that, in case the last half-wave of one group and the first half-wave of another group are cut out, there will be an interval of a half-wave between these occurrences. This is found to be necessary for the proper operation of the main line relay at the receiving station.

From the manner in which these half-waves are cut and the signal sent over the line, it is evident that each operator works independently of the other, and that no conflict between the signals which are sent by each can possibly occur. It is likewise evident that four entirely different and independent signals can be sent in one direction in the one-quarter second during which the trailer passes around the commutator. Thus, it becomes clear how eight different and totally independent signals can be sent over the line in one-quarter of a second or 1920 a minute.

The operation of cutting out the waves at the other end of the line is precisely the same. The signals which are sent over the line appear at the distant end merely as two momentary pauses in the otherwise constant vibration of the tongues of the main line relay. It now becomes necessary to show how these transient signals are translated into a readable record and then into printed characters. Since the two ends of the line are in all respects alike, any description will apply to the one as well as to the other.

Referring to Fig. 5, L is the main line, and RA the main line polarized relay. This relay has two insulated tongues which vibrate synchronously with the alternating current waves arriving over the line, L. The tongue ts controls the synchronizer, S, which operates in the manner described above. The tongue, tp, has the functions to be described. C is a "receiving" commutator, practically identical in construction with the "sending" commutator. Sweeping around this commutator, which has 52 segments, there is a brush, or trailer, tr. This trailer is connected by gearing to the rotating synchronizer, S, but with a speed reduction of 13 to 1. The commutator may be rotated through a small angle, giving an adjustment, so that when the trailer, tr, is in the center of a segment the relay tongue, tp, is at that instant against either a left-hand or a right-hand contact. R is a resistance of several hundred ohms, to the terminals of which is connected a 110-volt direct-current circuit. A is a bank of small polarized relays, called the "selecting" relays. There are, in reality, four such banks of 11 relays each. Only one bank, however, is here shown. Each of these four banks corresponds to a keyboard at the sending end of the line. One terminal of each of these relay coils is connected to a segment in one of the groups of 11 segments of the commutator, C. The other terminals or "tails" of all the coils of all the relays are connected with the insulated tongue tp of the main line relay, RA. As the tongue of this relay vibrates between its contact points and the trailer travels over the commutator segments, synchronously with the vibrating tongue, the 44 relays will receive, in succession, momentary currents through their coils. The relays 1, 3, 5, etc., of each bank will receive a current through their coils in one direction, and the relays 2, 4, 6, etc., a current in the opposite direction. Thus, the tongues of the relays of even number would receive an impulse in one direction, and those of an odd number in the opposite direction. The windings, however, of relays of odd numbers are reversed, and this makes the tongues of all the relays receive, in succession, an impulse in the same direction as the trailer passes over the segments of the commutator to which they are attached. Thus, while the current on the line is unmodified, the tongues of all the "selecting" relays will receive an impulse in the same direction once each time the trailer makes a complete revolution. These repeated impulses, together with the magnetism in the tongues of the relays, hold them against their back-stops and away from the contact points, A, B, C, etc.

The cutout wave on the line will now be indicated in the following manner. When the wave is cut out, the main line relay tongue, tp, will at that instant cease to vibrate and will remain against the contact point which the previous wave had carried it. The trai in the meantime passes on to a segment such that, 11

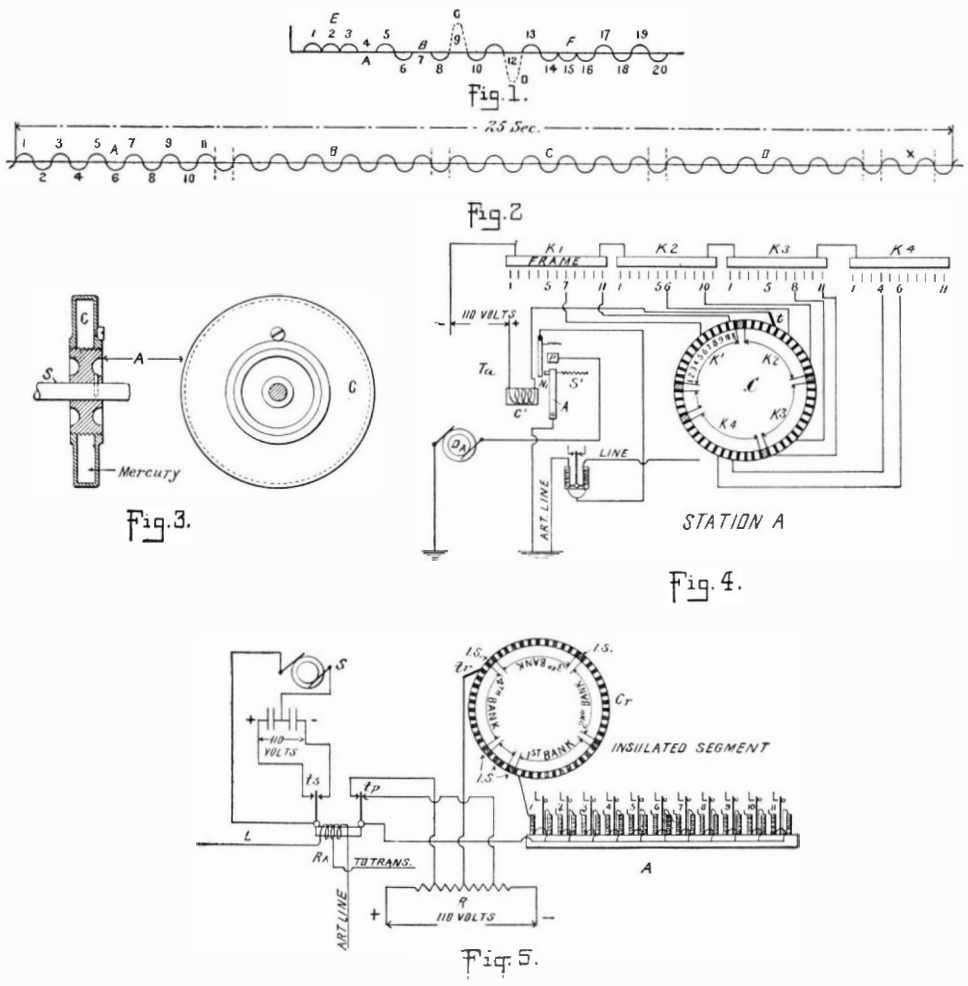
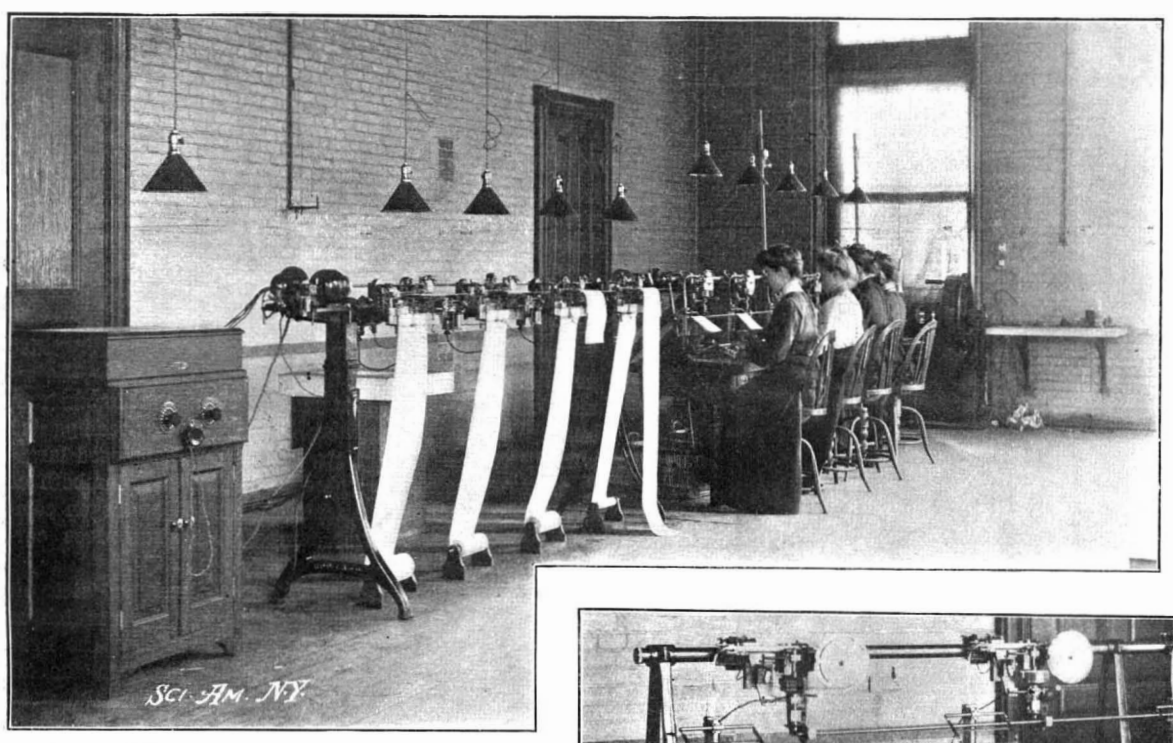
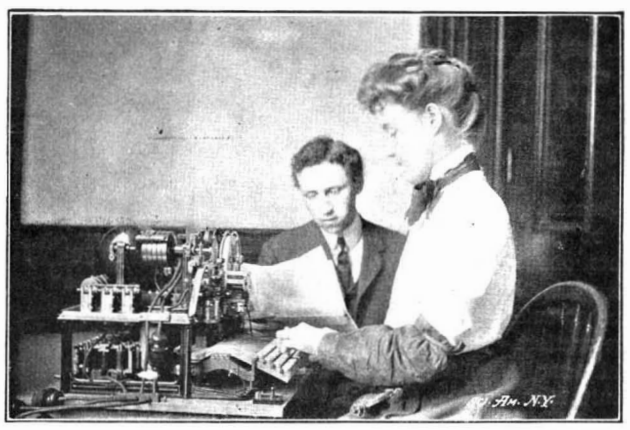


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

THE ROWLAND SYSTEM OF PAGE PRINTING TELEGRAPHY

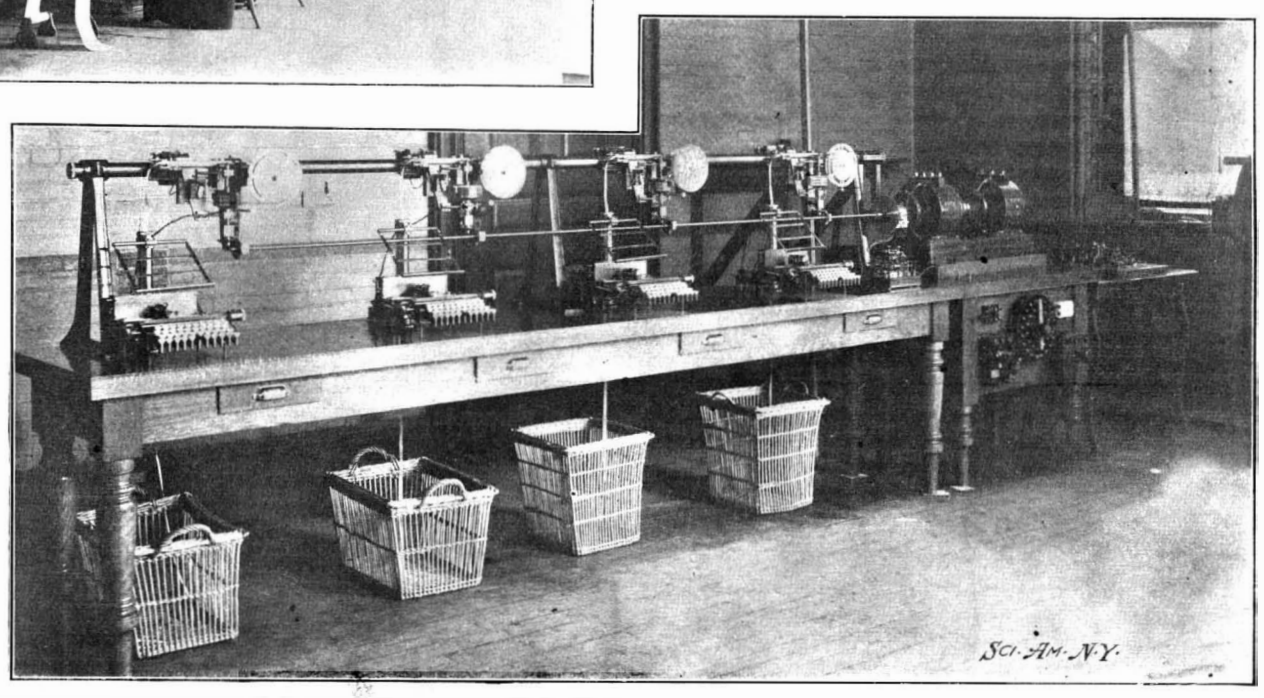


General View of Transmitters and Printers.



Transmitting a Message.

Receiving a Message on the Page-Printer.



A Group of Keyboards. Main Line Relay and Transmitter to the Right.

THE ROWLAND MULTIPLEX PAGE-PRINTING TELEGRAPH.

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the main line relay tongue had been carried over, the selecting relay attached to that segment would have received an impulse to take it against its back-stop. Now, however, this selecting relay will receive a current through its coils in a reverse direction to what it would have received had the main line relay tongue continued to vibrate. Its tongue will, therefore, be thrown against its contact point, and will remain there until the trailer has made a complete revolution. When the trailer returns to the segment to which the relay is attached, unless some wave is again cut out, the relay will receive an impulse which will return its tongue to its backstop again. Thus, waves which are cut out at the far end of the line are reproduced at the near end by the tongues of the selecting relays which correspond to the wave cut out, being thrown against their contact points, *A*, *B*, *C*, etc., and there remaining during one revolution of the trailer. As each of the four keyboards at the far end of the line operates a corresponding bank of 11 selecting relays at the near end, the depression of any key of the keyboard, which cuts out two waves, will cause two relay tongues in the bank corresponding to that keyboard to be thrown against their contact points. A practised observer could readily interpret the cutout wave signals sent over the line by merely observing the movements of the tongues of the selecting relays. Tongues 1 and 3 sent over might be interpreted to mean *A*. 1 and 4 to mean *B*, etc., through the 45 possible combinations given above. But in the present system these signals are automatically translated into ordinary figures and letters of the alphabet which are printed upon a sheet of paper eight inches wide. It now only remains to show how this is accomplished.

The page-printer, by which the 41 different characters are printed in type, comprises essentially a light type-wheel of steel, about 2 inches in diameter, on the circumference of which 41 characters are engraved. This type-wheel revolves continuously at the end of a horizontal shaft which turns synchronously with the trailer. A light paper carriage carries the paper fed from a roll beneath the type-wheel when new lines are made. Devices are employed for thrusting the paper forward to make lines, and sideways to space letters. Back carriage devices return the paper to a position where a new line of print is to start. A small printing magnet operates a hammer which strikes the paper up against the lower side of the wheel rim, at the moment when the character to be printed has turned to its proper position above the hammer. A set of four polarized relays, called "distributing" relays, serve the purpose of making contacts at proper moments for sending current to the printing magnet to print, to a liner magnet to line the paper, to a spacer magnet to move the paper sideways, and to a back magnet which allows the carriage to return the paper to the proper position when beginning a new line.

In keyboards of the latest page-printers, contacts are electrically made. Fifty-six waves are divided into four groups. Of the waves in each group eleven are used for the printing; one wave in one of the groups is used for finding the letter; and three waves, one taken from each of the remaining groups, are reserved for purposes of signaling. The signaling can be effected in a number of ways. Morse instruments, one at each end of the line, can be worked duplex at a slow speed. It is preferable, however, to place at each end of the line, in addition to the four page-printers, a small page-printer, both of which print simultaneously at the rate of fifteen words a minute each. While the eight printers of the duplex system are in operation with the transmission of telegrams, the two stations can correspond with each other regarding business of the office, for the purpose of correcting errors. The system may, therefore, be called, with propriety, a "decaplex" system. In the later machines an additional important feature has been embodied whereby it is rendered possible to record at the sending station all messages which are transmitted.

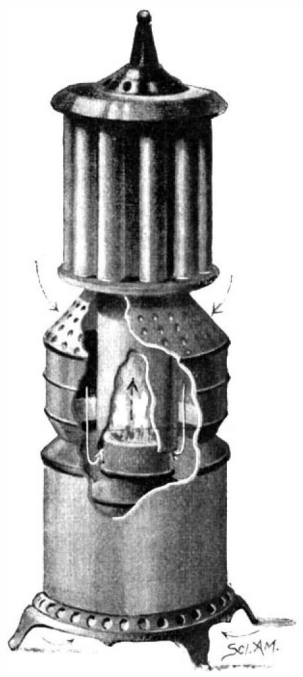
It is claimed that the octoplex system can transmit to greater distances without relaying than other multiplex systems hitherto known. It has been successfully operated under government tests over a line of 550 miles; it is anticipated that it will work perfectly without relaying between New York and Chicago. Methods were, however, devised by Prof. Rowland for automatically relaying the messages.

Whatever may be the various applications of the Rowland system, and they are many, the octoplex capacity can be distributed in any convenient manner, that is, in place of having 8 operators, and a speed of 40 words per minute each, the number of operators can be doubled and the speed of each halved; or any number of operators can be employed with the limitation that the aggregate speed of the apparatus shall not exceed that of the eight operators at 40 words. In cases where branch lines radiate from a central, these lines may be 300 miles or longer. Or in cases of slightly different apparatus, placed at the terminal of the branch, these branches may have any length up to the maximum of the system. Way station lines may have any length up to 300 miles.

In this description it has been attempted only to give a bare outline of the features of Prof. Rowland's remarkable invention. Much more might be said of the many ingenious devices used and the new mechanical features employed. Throughout the apparatus is the practical embodiment of beautiful physical principles and mechanical devices. One very important characteristic is the natural way in which the system divides itself into distinct units. If one unit becomes deranged, another may be immediately substituted without stopping the operation of the rest of the apparatus.

SUBSTITUTES FOR COAL IN HEATING AND COOKING.

Although the strike in the anthracite coal fields is happily ended, it will take a few months to bring the supply up to the demands of the public, and consequently the price of hard coal is likely to remain at

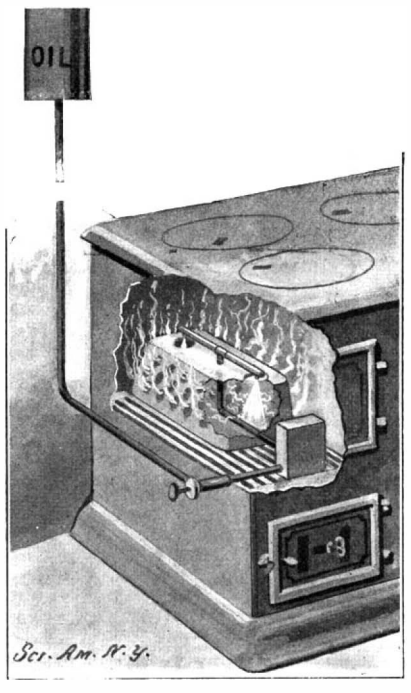


A Type of White Flame Wick Heater.

a figure which will cause the majority of the "housekeeping" public to look around for a cheaper fuel than coal at anywhere from $9 to $12 a ton. The Scientific American has investigated the problem with results which are tabulated below.

1. Electricity can hardly be considered as a factor, for two reasons; first because but a very small proportion of the populace are situated so as to be able to have the current delivered to their houses, second because the cost of heating by electricity would be so very high as to preclude the possibility of its general adoption.

2. Soft coal, apart from its very high price and the difficulties in the way of getting it, requires such radically different treatment from hard coal in order to burn it, that its adoption as a substitute for anthracite will necessarily be limited. In burning soft coal it must be remembered that, because of the much greater quantity of gas contained in it, care must be taken not to overload the fire box. In starting the fire, the grate must not be filled more than half full, and the fire must be replenished a little at a time. Air must be permitted to reach the fire from above as well as from below, and this may be accomplished by opening the broiling door or by slightly opening one of the lids at the back of the stove.



Range Oil Burner in Which the Oil is Fed by Gravity.

Owing to the large amount of unconsumed carbon which passes into the chimney, the latter will require careful attention, since the flues—at least in modern houses—are usually built for the burning of hard coal, and being of rather small area, they are very likely to become choked with soot. If the chimney should catch fire, the fire may be quickly extinguished by throwing a handful of common roll sulphur upon the glowing coals in the grate, closing down all the openings to the stove and covering the top of the chimney. The gas produced by burning sulphur—sulphur dioxide—does not combine with carbon, and therefore the fire in the chimney will be quickly put out. The chimney must be kept closed up until well cooled.

Chimneys which are provided with a hole at the bottom for cleaning purposes may be easily cleaned by dropping a pailful of pebbles down from above. These carry most of the soot down with them to the bottom, whence the matter is easily removed. The main precautions to be observed are to maintain a moderate fire, and to put on only small quantities of coal at a time.

3. Gas seems but a broken reed to lean upon, since the companies are utterly dependent upon the coal supply. Moreover, for heating a house from a basement furnace gas is very expensive. A talk with a representative of one of the largest gas stove manufacturers brought out the fact that when used in a hot-air furnace—a furnace by the way *specially* constructed to burn gas—it would cost as much to heat a house by gas as it would to heat it with a coal furnace burning coal at $20 per ton, and this, taken in connection with the cost of installation of the special furnace, would preclude the adoption of this means of heating to any appreciable extent.

The economy which the gas cooking stove exhibits when compared with an ordinary range is entirely dependent upon the fact that in cooking with the gas stove nearly the whole of the heat produced by the gas is utilized, whereas with the range much of the heat produced is used to raise to a high temperature a large mass of iron; further, a fire once started in a range must burn for a considerable time after one is through cooking, while the consumption of fuel in the gas stove ceases directly you are through. It will therefore be quite evident that though the range burns by far the less expensive fuel, such a great proportion of the fuel energy is wasted that the gas stove is able to show an economy of operation just as long as the heat is required concentrated upon a particular place, and as long as the time during which the heat is actually required is comparatively small. The problem of house heating does not, however, conform to either of these conditions. In this case the heating of a large mass of metal is a positive advantage, as it gives a greater radiating surface, and since the heat must also be constantly maintained it is quite evident that the range, using as it does the cheaper fuel, is the more economical.

4. Oil stoves being entirely independent of the coal supply for the production of their fuel, naturally present a more promising field for investigation than anything we have thus far considered. They may be roughly divided into two classes; first, those which use a wick, and burn with a white or yellow flame, and second, the wickless or blue flame oil stoves. The latter are to be recommended as the more efficient heaters. An understanding of the principles of combustion will make this last point clear.

The process of combustion is in a chemical sense nothing more than the union of the oxygen of the atmosphere with some material for which it has such an affinity or attraction that the union is accompanied with light and heat. Now, kerosene is composed largely of two substances, hydrogen and carbon, for both of which oxygen has an attraction, though hydrogen combines at a much lower temperature than does carbon.

In lighting an ordinary kerosene lamp or wick oil stove this is what takes place: You apply a match to the wick, which is saturated with kerosene; the heat vaporizes a little of the oil, the hydrogen in the oil combines with the oxygen of the air, and the heat produced by this union heats the carbon of the kerosene white hot, and thus we get the familiar whitish-yellow flame of the kerosene lamp. The carbon does not, however, thoroughly combine with the oxygen, and in consequence a great deal of the heating possibilities of the flame is lost, though the flame serves as a fair illuminator.

In the blue-flame oil heater a different condition of affairs exists. The kerosene, which is stored in a reservoir, is permitted to flow slowly into a vaporizing device, from which it passes to a burner. In one of the stoves shown the vaporizing device is a circular trough, made of cast iron, which is heated to a very high temperature. This vaporizes the kerosene and the vapor thus produced is compelled to pass between two walls of red hot metal while at the same time heated air is caused to act upon it. The temperature to which the vapor is raised by this means is so great that *both* the hydrogen and carbon are compelled to combine

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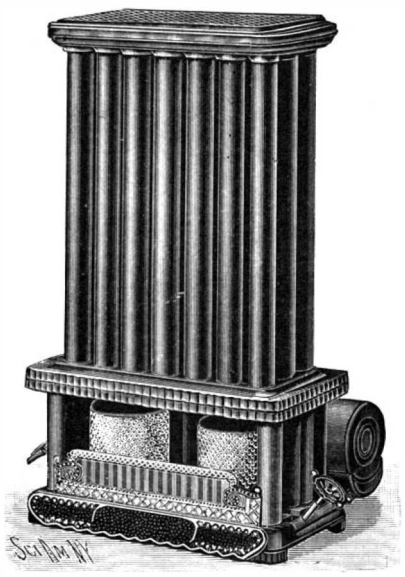
with the oxygen, and, the united energy of combination of hydrogen and carbon in combination with oxygen being greater than that of hydrogen and oxygen in combination without the carbon, the flame is much hotter. Since the carbon of the kerosene is completely burned

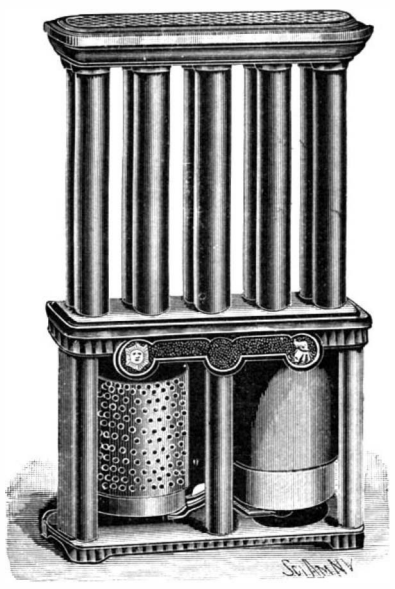


Blue-Flame Wickless Heating Oil Stove.

instead of being merely heated white hot, there is but little illumination with this flame.

The wickless stoves burn about 22 hours per gallon of kerosene per burner.

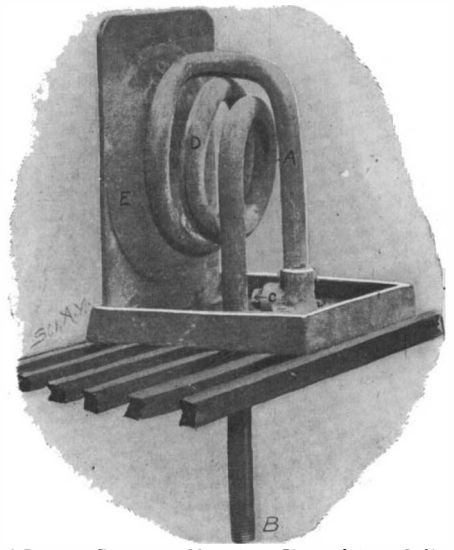
In buying a blue-flame oil stove care should be taken to secure one in which provision has been made to avoid "flooding" the burner. The simplest method of attaining this result is shown in the accompanying sketch. In this the main reservoir—which by the way may be detached from the stove and filled while the stove is in action—is so arranged that the opening of its valve dips just below the surface of the oil. When



Another Type of Blue-Flame Stove. Radiators May be Removed and Cooking Section Used.

the consumption of oil by the burner causes the level of oil in *M* to fall far enough to unseal the valve of *J*, oil rushes from *J* into *M* until the level is restored. In actual practice the working is so delicately adjusted that the oil comes from *J* a drop or two at a time, so that the level in *M* is practically constant; and since this level is below the upper edge of the oil chamber in the burner there is no possibility of an overflow even though the valve *Q* be carelessly left open.

There is one type of oil burner which under present conditions promises to have considerable influence upon the situation. We present an illustration of two



Detail of Range Burner, Showing Vaporizing Coil and Reflector Lamp.

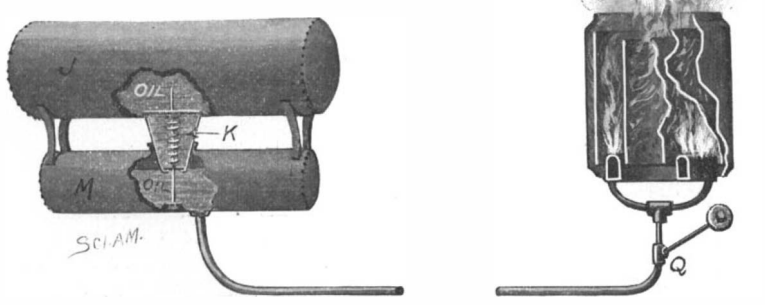
of this type. One of these has a burner which is intended to be placed directly in the firebox of a range or furnace with a view of acting as an economical substitute for the ordinary coal fire. The burner, which is made in Philadelphia, has been in use in that city for sufficient time to demonstrate its worth. An expert with whom the writer talked declared that this burner was one of the best he had seen tried during the whole of an experience of ten or twelve years. The burner consists of a coil of ⅝-inch outside diameter iron tube affixed as shown in the adjoining cut, to a cast-iron trough. The vertical plate *E*, thickened where the flame strikes it, is so placed that the flame impinging upon it is reflected back on the coil. There is an exceedingly fine hole (No. 70 drill gage) through which the vapor from the kerosene is forced.

The burner is placed in the range so that the supply pipe *B* is vertical with the inlet downward, the outlet being connected by an iron pipe to a tank in which kerosene is stored under an air pressure of 3 to 10 pounds per square inch. The oil supply to the burner is regulated by a needle valve.

To start the burner in operation the needle valve is opened, upon which, the pressure in the oil tank forces kerosene into the coil, finally forcing a fine spray from the hole at *A*, and this oil dripping from the turns of the coil falls upon a sheet of asbestos, which is in the trough, and is soaked up. The needle valve is then closed and a match applied to the asbestos. The oil in this, catching fire, heats the coil and in a short time—perhaps 60 seconds—the coil becomes so hot that the kerosene in it is vaporized and forced in this condition through the hole at *A*. Catching fire as it issues, it produces an intense heat which impinges on the plate *E* and the turn of the coil. The coil thus becomes exceedingly hot, and as the needle valve is again opened a fresh supply of kerosene flows into the coil to be converted into vapor. Thus the flame is maintained. The burner owing to the very small hole used burns but little kerosene—about 1 gallon in 10 hours at 10 pounds pressure. Five pounds pressure is, however, ample for cooking stove work. Air pressure is obtained by means of a small pump attached to the reservoir, and the amount is indicated by a gage.

We also present illustration of a blue-flame burner adapted for use in the firebox of an ordinary kitchen range, which is similar in principle and general operation to the burner just described, except that the air-pump is dispensed with, and the pressure necessary to feed the oil is obtained by placing the tank of oil at a sufficient height above the burner to secure a flow of the oil by gravity. The oil is led through a needle valve which is placed just outside of the fire door, into a small iron rectangular box placed just within the fire door, where it is vaporized by the heat of the burner. From the vaporizer a pipe leads the vaporized oil to a length of horizontal pipe which extends, as shown, above a perforated cast iron box. At the two ends of this horizontal pipe and on its under side are two fine pin holes, through which the vapor issues in a fine jet and burns with the characteristic hot blue flame. The force of the jet drives the hot flame down through a couple of inch-and-a-half holes, located in the top of the iron box immediately below the jets. The flame and hot products of combustion fill the perforated box and pass out through the perforations, raising it to a red heat, and producing a sufficient amount of heat for the general cooking purposes of the stove.

To start the stove it is only necessary to thrust two pieces of ordinary newspaper into the holes in the box, open the needle valve and allow the oil to drip upon the paper. When the latter is saturated, it is lighted by a match, and the heat of the burning paper will in a few minutes vaporize the oil in the pipe and start the regular blue flame action of the burner.



Detail of Automatic Oil Feed and Blue-Flame Burner.

Sawdust Fuel Briquettes.

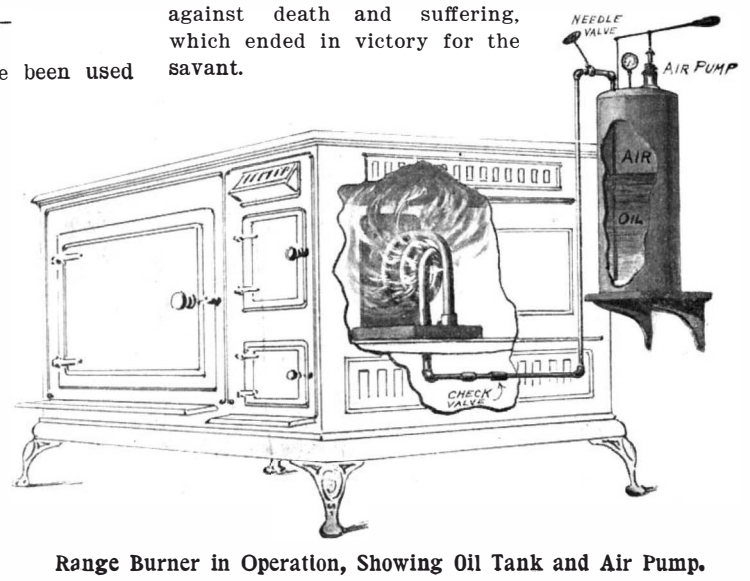
Sawdust in cake form appears to have been used as fuel in Germany with rather promising results. United States Consul A. L. Frankenthal, writing a short time ago from Berne, Switzerland, says that the sawdust cakes are octagon-shaped, 6½ inches long, 3½ inches wide and three-quarters of an inch thick, weighing about half a pound each. In the district surrounding the factory where these cakes were made the schools were heated by them, the combustion leaving very little ash and proceeding without a large flame. No binding ingredient is said to be used, the sawdust being simply dried and pressed into the desired briquette shape, and owing thus to the absence of tarry or oily substances there is no smoke in burning. The weight of such a briquette indicates the heavy pressure under which it takes its shape, and the edges look like polished oak; in fact, it is heavier than a piece of hardwood of the same size. The demand created by the popularity of the fuel exceeded the supply of sawdust obtainable in the vicinity of the factory, and shiploads were, therefore, procured

Blue-Flame Burner, Showing Cast Iron Trough, Regulating Valve, and Cylindrical Case.

from Sweden and cartloads from distant manufactories. Sawdust, which previously could be had for the asking, commanded a market price as soon as it was known that a certain factory could make use of it. Even then it was profitable to manufacture the briquettes; but, unfortunately, the factory was destroyed by fire and operations came to a standstill. Making sawdust briquettes of this kind would, therefore, seem to be worth inquiring into further.

A Statue to Pasteur.

On August 5 a statue erected to the memory of Pasteur was unveiled at Dolê, the birthplace of the great chemist. The following account of the ceremony is given by the French correspondent of the Chemist and Druggist: Nineteen years ago, on July 14, 1883, the Doloise municipality commemorated the fact by placing a marble slab on the modest house where he was born on December 27, 1822, in the Rue des Tanneurs, now called Rue Pasteur. For the inauguration of the statue the townspeople had made extensive preparations, and all the local notabilities, including the members of Parliament, were present. The government was represented by M. Trouillot, Minister of Commerce, who made the distribution of medals and decorations that is customary here on such occasions. He afterward proceeded to the ceremony of unveiling the monument, and made an interesting speech, in which he traced the life of Pasteur. The Minister referred to it as an incessant struggle against death and suffering, which ended in victory for the savant.



Range Burner in Operation, Showing Oil Tank and Air Pump.

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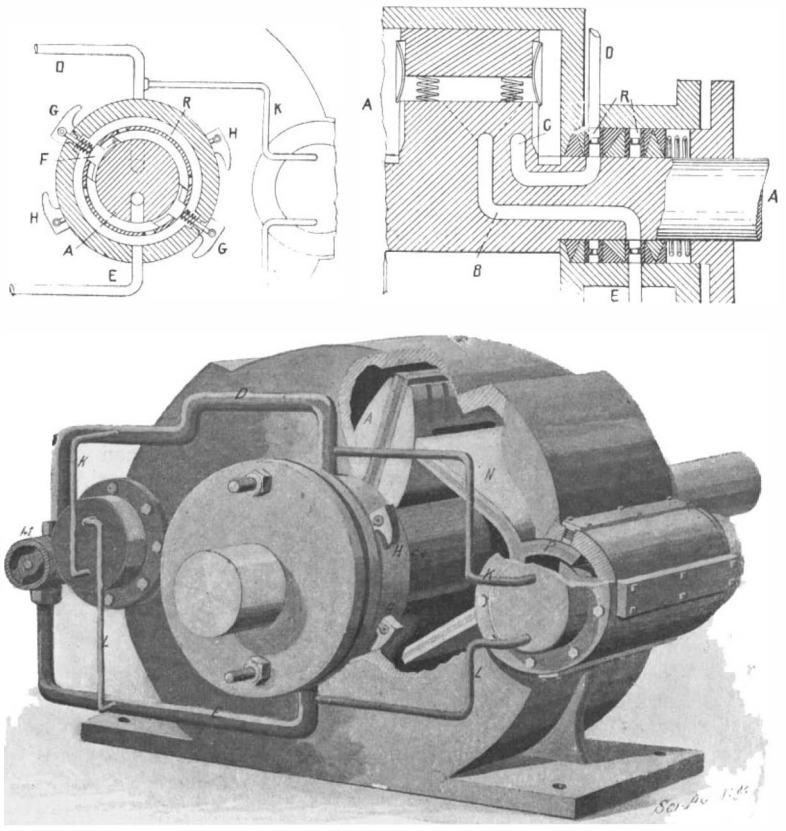
A NOVEL ROTARY ENGINE.

Among the many recent developments in rotary engines one worthy of special notice is that shown in the accompanying illustrations. A patent on this engine has recently been granted to Oliver C. Jones, of the United States Navy, residing at 315 Carson Street, Manayunk, Philadelphia, Pa. Mr. Jones' engine embodies some very novel features of construction. The peculiar arrangement enables him to drive his engine in either direction and to utilize the steam force under continuous impact or, with certain cut-off devices, to work the engine expansively for such periods of its operation as may be desired.

The general view of the engine is broken away to show the piston, *A*, and one of the reciprocating abutments, *N*, which co-act with the piston to turn the main shaft. The cylinder or casing is provided with two offset portions at each side in which the abutments, *N*, are permitted to rock. The abutments are connected in pairs to two shafts journaled respectively in boxings at either side of the cylinder. Projecting from each abutment is a tailpiece, *P*, these tail-pieces working in cavities formed in the boxings. The cavities are each divided by a horizontal strip into an upper and lower compartment. The ports which lead therein have connection with the steam pipes, *D* and *E*, through pipes, *K* and *L*, respectively. It will be noticed that pipe *K* leads to the upper compartment and pipe *L* to the lower compartment in the right-hand boxing, while the reverse holds true at the left. A four-way valve *M* is provided, whereby either one of the pipes *D* and *E* may be connected to the steam supply, while the other is connected with the exhaust. As shown, this valve is turned to supply pipe *D* with live steam, and pipe *E* communicates with the exhaust. Reference to the sectional view at the right will explain the course of the steam into the cylinder. This section is taken longitudinally through the engine shaft and the piston *A* formed thereon. Within the elongated box through which the shaft, *A*, extends are two annular channels formed by the chamber rings, *R*. These rings have an H-shaped cross section, and the webs or horizontal portions are perforated at various points along their extent. The inlet pipe *D* connects with the chamber at the left, and the exhaust pipe *E* connects with that at the right. Two ports lead from these steam chambers to the piston; one, the inlet port, communicating to the right-hand face of the piston, as shown in the general view; and the other, the exhaust port, leading to the left-hand face. When live steam is admitted into pipe *D*, a portion of the steam is led through the pipes *K* into their respective compartments where, acting on the tail-pieces, *P*, it swings the abutments on the left upward and rocks those on the right downward. The upper right-hand abutment, and the lower left-hand abutment are thus rocked into engagement with the piston, while the other two abutments take up positions out of the path of the piston within their respective offset recesses in the cylinder casing. Steam entering the cylinder through port *C* expands and forces the piston to the left. As the piston passes beyond the end of the upper left-hand abutment, steam flows into the recess back of the same and forces it downward. The piston will then engage the lower left-hand abutment, and aided by the steam pressure just referred to, will rock the two abutments downward. After the piston passes the lower abutment, the two abutments will rock back under steam pressure on the lower left-hand tail-piece *P*, to the upper position. While rocking to this position, the lower abutment rides along the steam-feeding face of the piston. A number of grooves are formed on each face of the piston just above the ports *B* and *C*. These grooves serve as by-passes which in this case permit the steam to pass downward below the lower left-hand abutment and, entering the offset recess, to press on this abutment and accelerate its return. The operations above described now take place on the right hand, the motions of the abutments, however, being reversed. Thus the piston is continuously rotated in one direction. When it is desired to reverse the engine, the valve *M* is turned, admitting steam through pipe *E* to port *B*. The abutments are also rocked to reverse position by steam entering through pipes *L*. Thus the piston is caused to rotate in the opposite direction. Suitable packings are provided throughout in order to make the parts all thoroughly steam-tight, and the novel methods of arranging these strips form a very important feature of the invention, which limited space does not permit us to describe.

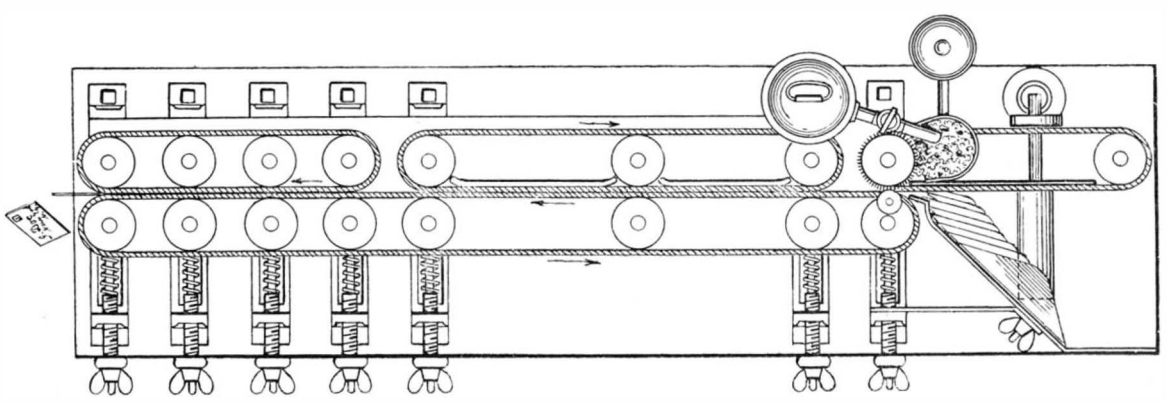


A NEW TYPE OF ROTARY ENGINE.

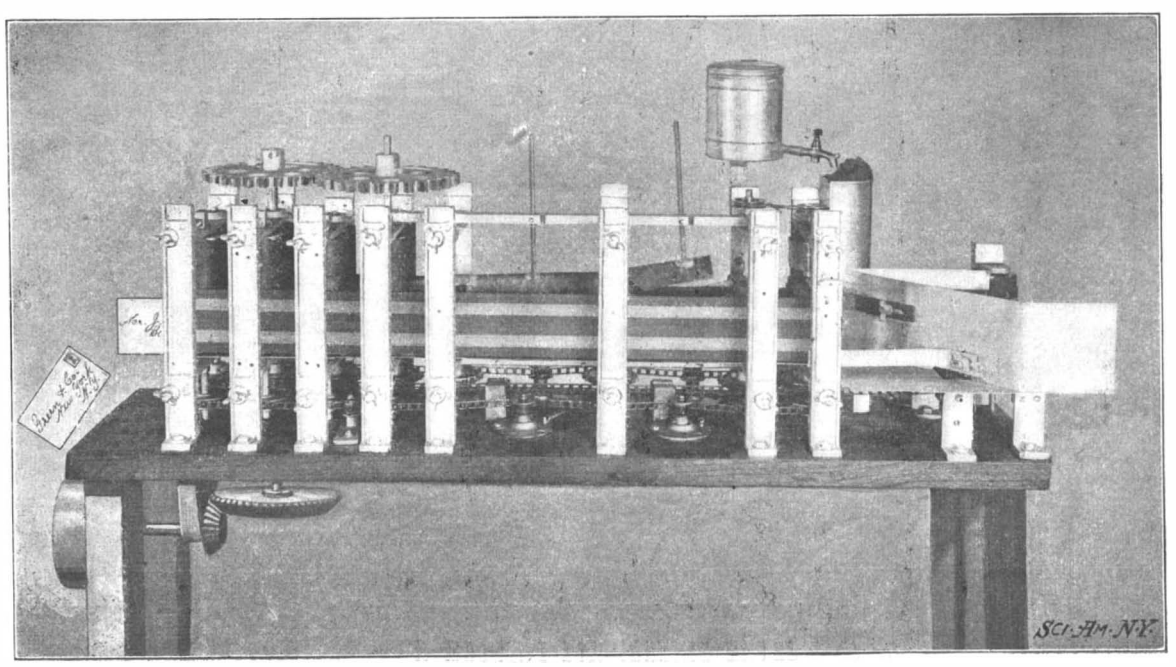
Bearing on the engine shaft within the steam chambers formed by the rings *R*, are several cut-off shoes *F*, which are adapted to close the ports *B* and *C* during part of their rotation. The cut-off shoes are shown in detail, in one of our sectional views. The shoes may be lifted out of engagement with the shaft by finger-cams *G* and *H*. With the steam feeding into the engine through pipe *D*, as shown, the shoes which close the port *B* are inert elements, and may be raised, if desired. The other shoes, however, should be allowed to bear on the shaft, so as to alternately cover and uncover the feed port, *C*. The steam is thus greatly economized, the piston being driven by the expansion of the steam, while the inlet port is closed. The periods at which the port is closed may be varied according to the size and number of shoes employed.

ENVELOPE-SEALING MACHINE.

A machine which gives promise of great usefulness has recently been invented by Mr. Harry E. Gavitt, of Topeka, Kans. This apparatus is adapted to receive unsealed envelopes, moisten and fold their flaps and then firmly press the flaps to sealed position. Our illustrations show one of these machines in operation. On the extreme right will be seen the gage plate, back of which are placed the unsealed envelopes with flaps upturned. As many as fifty envelopes of mixed thicknesses may be placed in the hopper, but only one at a time will be fed forward automatically into the machine. This is regulated by the spring gage plate which is self-adjusting, allowing a wider or narrower entrance to the machine, according to the thickness of the envelopes to be sealed. The envelopes are fed forward by a roller in the floor of the hopper and by a traveling belt which forms one side of the same. Just beyond the hopper is a moistening device consisting of a roller covered with canvas, which receives the moisture from a sponge and deposits it on the gummed flap of the envelope. From this point the envelope is fed forward between two belts under the folding device, which consists of a metal sheet twisted laterally and rearwardly in such a manner as to bend the flap down before it passes under the flap holder. The latter is a piece of sheet metal, forming an inverted U in cross section, by which the flap is held in folded position, but is not pressed against the envelope. The feeder-belt at this point, which bears against the folding side of the envelope, is narrow, so as to clear the flap which is turned over. The next feeder-belt, however, has a width equal to that of the envelope, and in feeding past this the flap is firmly pressed into sealing position before being discharged from the machine. The reason for delaying the sealing action by introducing a flap-holding device is to permit the mucilage to thoroughly absorb the moisture and to become properly softened before the flap is pressed against the envelope. The sponge which supplies the moistening roller is situated in a receptacle adjacent thereto. Water is fed to the sponge from a reservoir situated above, and a can is provided at the rear of the machine into which any surplus moisture is drained. The feed and pressing rollers are driven by chain and sprocket gearing from a pair of bevel gears which are rotated by the driving pulley. The long belt, however, which is situated nearer the front of the machine is driven by frictional engagement (or chain and sprocket) with the shorter belts against which it is pressed by spiral springs. These springs, which are clearly shown in a sectional view of the machine, are self-adjusting for envelopes of unusual thickness. The machine will seal from 8,000 to 15,000 envelopes per hour of any ordinary bulk, mixed sizes, and especially adjusted will seal envelopes at about the same rate up to one-half inch in thickness.



SECTION SHOWING COURSE OF ENVELOPES THROUGH THE MACHINE.



A MACHINE FOR SEALING ENVELOPES.

The United States Naval Department is about to ask for bids for the construction of a floating drydock for the Philippines. It will be built here and floated to its destination, and will be of sufficient capacity to raise a 16,000-ton battleship. The available amount is $1,250,000.

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RECENTLY PATENTED INVENTIONS.

Agricultural Machinery.

COMBINED HARROW AND SEED PLANTER.—A. C. PALMER, West Union, Iowa. In this machine the seed-planting mechanism may be combined with harrow devices or the latter may be used separately, thus saving the farmer the expense of buying two machines and enabling certain kinds of seed to be planted in the soil to the best advantage. The mechanisms are so arranged that the machine may be turned in a narrow space at the end of the row. An improved dropping mechanism is provided and also a means for throwing the dropping mechanism out of service.

Electrical Contrivances.

STARTING DEVICE FOR ELECTRIC MOTORS.—T. M. PUSEY, Kennett Square, Pa. The invention relates to improvements in devices for starting electric motors, the object being to provide a simple automatic means for regulating the flow of current in starting the machine, and thus prevent burning out. This is accomplished by means of a solenoid wound with two coils. One of these coils which is wound to high resistance acts to raise the core as the speed of the motor increases and thus cuts out the resistance in the rheostat.

ELECTRIC MOTOR OR GENERATOR.—J. A. TITZEL, Sr., Franklin, Pa. Mr. Titzel's invention relates to electric devices capable of use either as motors or as generators and has for its object to provide a construction by which a strong, and uniform magnetic field is obtained, so that the apparatus would be very efficient in either of its capacities.

STORAGE BATTERY.—H. P. KING, Osgood, Ind. The design of this storage battery is neat and compact and of such form as to combine the highest efficiency with the greatest economy of space. The battery plates are protected to some extent by their form and are arranged to be conveniently housed in an ordinary battery jar.

ALARM DEVICE FOR TANKS.—M. KUBITZKY and R. B. STEWART, New York, N. Y. These inventors have produced an economic form of electric alarm, especially adapted for use in connection with drip-pans, tanks, washtubs, and other receptacles, to indicate when the water or other liquid therein has risen to a predetermined level and thus tend to prevent an overflow from such receptacle.

Mechanical Devices.

ESCAPEMENT FOR TIMEPIECES.—F. H. VOIGT Philadelphia, Pa. The object of this invention is to provide certain improvements in escapements for watches, clocks and other timepieces whereby the action of the escapement is rendered more positive and the friction of the working parts is reduced to a minimum to insure long accurate life of the escapement.

SAWING APPARATUS.—J. A. BRINES, Fresno, Cal. The apparatus comprises an essentially U-shaped frame around which an endless saw is adapted to travel. The frame is adapted to swing from a center, so as to bring the saw into proper sawing position. The saw is driven by a motor. The operator may permit the frame to drop slowly and follow the action of the saw mill until the log is cut entirely through.

VALVE MECHANISM.—OLE SWENSEN, Sr., Cresco, Iowa. Means are provided in this invention for removing grit from a valve-seat and permitting the valve to be reground without necessitating its removal from its mounting. The valve is provided with two stems, one of which is hollow, and which serves to raise and lower the valve from the seat, and the other which serves to rotate the valve and grind its surface on the seat.

DUMPING VEHICLE.—G. R. WERNER, Colby, Kans. This dumping vehicle belongs particularly to that class used in connection with a grain header. The invention provides a device of this character which will operate to dump the grain on the ground in even rows, so that the grain will be in convenient shape for drying out before stacking.

APPARATUS FOR USE IN RAISING WRECKS.—T. JOHNSON and C. JACOBSON, Chinook, Wash. The invention belongs to that class of apparatus employed for raising wrecks in which hoisting devices are applied to some form of float and connected with chains adapted to be passed around the submerged wreck. This improved form of apparatus may be easily manipulated and is adapted to maintain its position upon the float.

COTTON-PRESS.—W. H. MECOM, Columbia, La. This cotton-press is provided with an improved bale-box revolubly supported on a frame in an improved manner. Improved reversing means are provided for driving the bale-box follower alternately in opposite directions.

BORING AND TENONING MACHINE.—A. A. KOCH, Montezuma, Iowa. The invention provides an improved boring and tenoning machine which is of simple and durable construction and may be easily manipulated to accurately form tenons on the ends of wheel spokes and to bore fellies and other articles.

TURN-TABLE FOR USE IN MINES.—W. L. EPPERS and J. HAMILTON, Mount Washington, Md. These inventors have provided an apparatus by which the shaft cars may be transferred to and from the galleries or levels with ease and rapidity, so that the transfer of the mined product is unnecessary. In brief, a car once loaded in the gallery or level is run to the shaft and then transferred to the shaft track and hauled out of the mine.

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(8722) K. T. asks: 1. Is it possible to synchronize a dynamo and a motor, the latter run by the former, with reliability as to small variations of speed? A. The single-phase motor must closely synchronize with the dynamo which furnishes the current. Direct-current motors need not do so. 2. If so, will you give directions for building a simple and inexpensive model to illustrate the fact? For my purpose the minimum speed would be about 600 revolutions a minute and the maximum 2,400. The sensitivity ought to be such that any small variation of speed in the dynamo is transmitted to the motor with reasonable accuracy. A. The simplest model you can have to illustrate this is two similar machines, one driven as a dynamo and the other turned by it as a motor. 3. Can a 110-volt direct-current readily be transformed to a 52-volt alternating of any frequency, and how, with the least expense? A. A direct-current 110-volt is readily transformed into an alternating current of 52 volts pressure by a rotary converter such as is used in stations for this purpose. 4. Can a 100-volt direct current be used for heating metals by immersing in water, and how? A. A 110-volt direct current is not of a pressure high enough to heat metals quickly in water, as in the water pail forge; 220 volts are needed. Salt water is put into a pail in which a lead plate forms the electrode, while the iron attached to the pole is inserted into the water. It is instantly made red hot.

(8723) W. A. B. asks for a formula for glaze or glazing used in the manufacture of candies and crackers. A. Boil sugar and water to a point just before it will pull out stringy between the fingers. Dip in this solution.

(8724) W. M. C. says: I have a brass coil boiler, in which there is a great deal of sediment and scale and which is steaming poorly; please advise me what preparation I can clean it out thoroughly with. A. You can clear the sediment and incrustation in your boiler by injecting a strong solution of caustic soda, say 10 per cent of the contents of the boiler, using it for the day; then blow out while steam is up, and repeat for a few days.

(8725) C. R. says: If I were to take a cannon 3 inches in diameter and 1 inch bore and fit a screw cap firmly on the mouth of it, and then explode a piece of guncotton within, while the cap is screwed on: 1. Would the cannon burst? A. Plugging up a cannon charged with guncotton is a dangerous experiment. The charge would burst the cannon or blow out at the vent. 2. After cooling it would there be any explosion upon unscrewing the cap? A. There will be no danger in opening the cannon after explosion if it did not open itself. 3. Do you think the heat generated within the cannon would be sufficient to melt an iron or brass screw ¼ inch or ⅛ inch in diameter? A. The heat of the explosion is too quick to melt the screw.

(8726) C. G. asks: How can I remove nitric acid stains from a blue cloth coat and bring it back to its former color? The acid having been dropped on the cloth and pressed with a smoothing iron, causing the part of the cloth where the acid dropped and was pressed to turn yellow. A. The stain caused by nitric acid on blue cloth can be removed by the *immediate* use of ammonia, in case the acid was weak. Strong acid will usually give a permanent stain. With an old stain from nitric acid nothing can be done.

(8727) A. K. B. wants a receipt for canning corn that will make it keep in tin cans and not ferment. How is it canned to make it keep? A. It is necessary to cook the corn sufficiently to destroy all bacteria that would produce fermentation. Seal while still hot, so that no air can gain access to the corn. Salicylic acid is commonly used as a preservative: the failure to secure good results has probably been due to the fact that salicylic acid does not dissolve readily in cold water, and hence it may have separated out. Borax, and especially boracic acid, are used most largely to-day. The bulk of testimony seems to indicate that moderate amounts of these produce no injurious effects upon the human organism, but seem to be thoroughly eliminated through the action of the kidneys.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

October 14, 1902,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Accumulator, J. B. Relin 711,122
Acid and making same, polyamidoanthraquinone sulfo, E. Hepp 711,310
Acid by the contact process, apparatus for making sulfuric, G. C. Stone 711,186
Adding machine, M. Garrison 711,392
Adding or subtracting rule, N. H. Kodama. 711,252
Adjustable chair, J. E. Archambeault 711,412
Alkaline hydrosulfites and making same, solid, M. Bazlen 711,377
Animal shears, R. Shedenhelm 711,129
Annealing apparatus, J. J. Tynan 711,138
Arsenic, etc., apparatus for separating and recovering fumes of, G. C. Stone 711,188
Arsenic fumes from furnace gases, separating and recovering, G. C. Stone 711,187
Axle, W. J. Galerno 710,964
Axle spindle, self-lubricating, J. Y. Brown. 710,944
Bailing press, E. Byars 711,097
Ball, see playing ball.
Balls, manufacture of playing, E. Kempshall 711,215
Basin, wash, J. Totham 711,238
Basket, cotton, W. L. Means 711,410
Bell, electric, C. L. Burlingham 710,946
Belt roller support, conveyor, E. C. Bacon. 710,936
Belt supporting loop attachment, A. L. Brinckle 711,149
Bicycle hub clutch, C. M. Rhodes 711,001
Bicycle saddle post, adjustable, P. N. Goodrich 711,205
Billiard or pool table, W. S. Wickham 711,030
Binder case, transfer, E. B. Goodman 710,965
Bobbins, cops, etc., packing and holding device for, D. G. Baker 710,937
Boiler pipe cleaner, J. H. Williams 711,370
Bolster spring, N. Haverson 710,969
Bolting machine, J. C. Maun 711,222
Book and study table, A. F. Hawkins, Jr.. 711,048
Book, file, G. W. Buskirk 710,947
Boot or shoe, A. F. Littlefield 711,058
Boot or shoe cleaner, Bengtson & Gustafson 711,194
Bottle closure, F. W. Leuthesser 711,430
Bottle washing machine, W. J. Cunningham 711,244
Bottles, cans, etc., top for tooth powder, H. B. Kent 711,052
Bottles, etc., closure device for, R. B. Yerby 711,146
Bottles, machine for forming narrow neck, J. Haley 711,159
Box, H. L. Averill 711,374
Box contents indicator, E. K. Zaring 711,240
Box for packing rings, etc, E. L. Toy 711,024
Box form, expansible, C. W. Hobbs 710,975
Box machine, F. G. Pennock 711,119
Brake for street car railways, etc., H. T. Brown 711,280
Brooder, M. J. Mapes 711,409
Brush, A. R. Wiens 711,141
Brush making machine, J. F. Mumford 711,065
Brush, tooth, F. T. Rench 711,075
Button fastener, collar, W. E. Emery 711,390
Button, metallic, R. McKay 710,991
Button, tufting, H. Higgin 711,312
Button turning machine, pearl, J. Loog 710,985
Buttonhole and button location marking machine, Powell & Vaughan 711,175
Camera, photographic, F. W. Merrick 711,064
Can cover, Dravo & Miller 711,100
Can cover, M. J. Lawless 711,405
Can opener, H. Sidman 711,355
Can washing machine, J. Kellington 711,427
Car brake, J. Toner 711,084
Car brake, C. M. Haynes 711,208
Car coupling, G. A. Hermanson 711,160
Car draft and bung frame, combined, L. T. Canfield 711,283
Car draft rigging, R. V. Sage 711,265
Car, dumping, Farlow & Schimpf 711,420
Car fender, street, R. A. Boettler 710,941
Car loader, box, G. F. Bartlett, Jr 711,193
Car, railway, H. M. Hoover 711,163, 711,164
Car step, T. Kendrick 711,051
Carbureter, G. M. Schebler 711,005
Carbureter, T. H. J. Leckband 711,429
Card holder and score card, playing, H. H. Freeman 711,103
Carriage, folding child's, S. R. Evans 711,247
Cartridge shell recapper and decapper, H. G. Robinson 711,231
Case. See Bindery Case.
Cashier, mechanical, Dement & Hull 711,151
Chair head rest, B. Pickering 711,259
Christmas tree holder, J. C. Kimsey 711,217
Churn, P. S. Henthorn 711,106
Cigar, E. A. Kline 711,250
Cigar-tip cutter and lighter, combined, F. L. Miller 711,171
Circuit closer, trolley signal, W. M. Chapman 711,036
Closet basins, device for securing seats and lids of, N. Rubenstein 711,127
Cloth steaming apparatus, W. Hebdon 711,399
Clutch, friction, H. Muir 710,988
Coat hanger, H. L. Wright 711,145
Cock attachment, gas, A. E. Kraeger 711,113
Coffin sides, apparatus for making, L. G. Kregel 711,054
Coffin sides, making, L. G. Kregel 711,055
Coke oven, retort, Wilcox & Wagener 711,268
Combination lock, H. C. Lowrie 711,325
Condenser, steam motor, A. P. Dodge 711,387
Connecting rod key, automatic, E. J. Brewster 711,241
Conveying and hoisting machines, cable carrier for, G. E. Titcomb 711,137
Copper from copper precipitate, recovering metallic, D. McKechnie 711,173
Cooking utensil, G. P. Coyle 711,385
Cotton chopper, W. B. Castles 711,417
Cotton compress, J. L. Sheppard 711,353
Counter, word, T. A. Smith 711,359
Covers for pots, etc., attachment for, M. J. Cameron 710,950
Crane and hoisting apparatus, T. D. Hollick 711,400
Cream, etc., apparatus for tempering, D. T. Sharples 711,009
Cultivator, J. W. Alexander 711,371
Currycomb, Greene & Wood 711,423
Cycle brake operating handle, A. Sharp 711,443
Damper, stovepipe or drum, C. C. McCurley 711,066
Demijohn holder, A. B. Park 711,339
Dental mandrel, G. J. Paynter 711,340
Denture, artificial, W. P. Lacy 711,324
Derailing switch, J. C. Hare 711,308
Desk lid support, W. Holt 711,315
Detonator and catapult, combined, A. Delgrande 710,956
Dish cleaner, J. W. & B. C. Read 711,000
Display clip, hat, A. Martin 711,253
Distilling apparatus, H. Hirzel 710,974
Distributing and dispensing device, W. A. Freise 710,963
Diving apparatus, E. B. Petrie 711,342
Draft gear and buffing apparatus, Raders & Meier 711,345
Dress shield fastener, J. Seligman 711,234
Driers. See rotary mechanical drier.
Drilling machine, A. W. Wigglesworth 711,448
Drinking fountain, poultry, F. Pohley 711,224
Dye and making same, dark sulfur, E. Culmann 711,038
Earring protector, M. Wolfberg 711,269
Egg beater holder, W. B. Smith 711,185
Electric battery, A. J. Cook 710,953
Electric circuits, device for locating breaks and grounds on, M. J. Myers 710,990
Electric conductor, underground, C. Borel .. 711,414
Electric current rectifying apparatus, G. B. Batten 711,276
Electric switch, C. J. Doran 711,246
Electric time switch, W. B. Coulter 711,198

(Continued on page 280)

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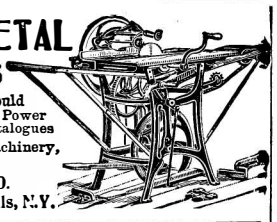

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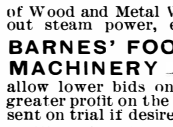

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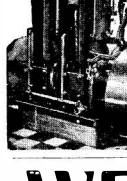

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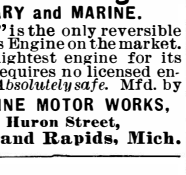

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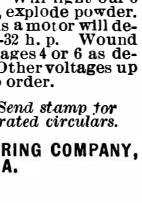

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Embalming apparatus, A. H. Grant	711,394
End gate securing rod, H. M. McGrew	711,336
Engines and tenders, running gear for traction, Miller & Austin	711,330
Engraving machine, J. Brady	711,094, 711,095
Engraving machine, P. V. Avril	711,273
Envelop machine thread gummer, J. L. Bowles	711,415
Excavating and constructing tunnels or other subterranean or submarine structures, C. Sooysmith	711,012
Excavator, G. H. Williams	711,449
Extension table, S. Dusenbery	711,042
Eyeglasses, F. Stewart	711,362
Fan, electric, B. Blum	710,940
Faucet, self-closing, W. Bunting, Jr	710,945
Feed table shifting mechanism, J. C. Cromwell	711,418
Feed trough, J. Ahrends	711,032
Fence making machine, J. & P. W. Sommer	711,011
Fence, wire, J. F. Donaghy	711,388
Fence, wire fastener, G. H. Wright	711,450
Fertilizer distributer, J. R. Ayers	711,274
File, document, W. S. Ebbets	711,301
Filing case, card, F. W. Tobey	711,447
Filter, G. F. Goddard	711,046
Fish or meat in cans, machine for salting, J. Kellington	711,426
Fish trap, P. M. Benseth	711,379
Fishing float, self-striking, C. Hymers	711,318
Flue cleaning cutter, rotary, C. B. Easty	711,043
Fluid pressure brake, T. J. Leabo	711,406
Flushing apparatus, closet, C. H. Rollins	711,232
Folding screen, J. Kaufman	711,322
Foot, tree, A. D. Tyler, Jr	711,025
Forage press, J. Ferrier	711,302
Fruit jar, D. Ray	711,260
Fruit or vegetable protector, Putnam & Berry	711,225
Fuel, artificial, W. A. Koneman	711,167
Fuel block or briquet, F. Chailly	711,242
Fuel briquet, artificial, W. A. Koneman	711,167
Fuse, electric, F. Bruggeman	711,150
Fuse for explosives, electric, F. Schroeder	711,006
Game, A. A. Caille	711,383
Game apparatus, G. W. Griswold	710,968
Game device, H. G. Higgins	711,424
Garden implement, H. H. Jensen	711,050
Garment supporter, H. C. Hine	711,313
Gas engine, E. G. Shortt	711,235
Gas engine, W. J. Wright	711,454
Gas furnace, Shaw & Foe	711,010
Gas generator, acetylene, P. P. & J. J. Reynolds	711,346
Gases or vapors, apparatus for reducing the temperature of, F. L. Dyer	711,419
Gases or vapors, reducing the temperature of, F. L. Dyer	710,957
Gear, electromagnetic transmission, H. A. Earle	711,300
Gearing, J. R. Carter	711,035
Glass grinding machine, W. McLaughlin	711,067
Glass working machine, I. W. Colburn	711,287
Gold and sulfurets, saving fine, F. M. Graham	711,047
Grain drill, J. A. Royster	711,003
Graphite, making, E. G. Acheson	711,031
Gun, machine, H. H. Kryger	711,218
Hammer, J. J. Green	711,206
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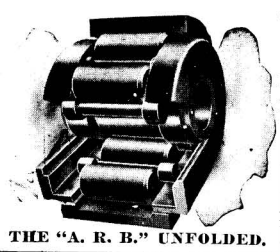

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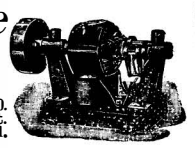

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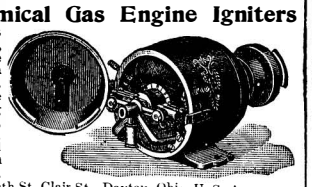

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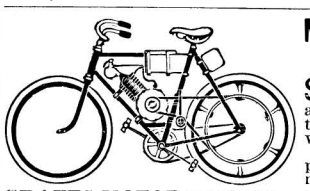

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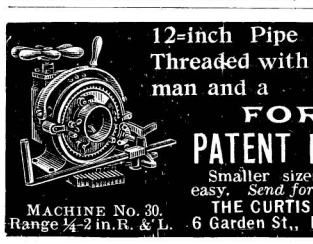

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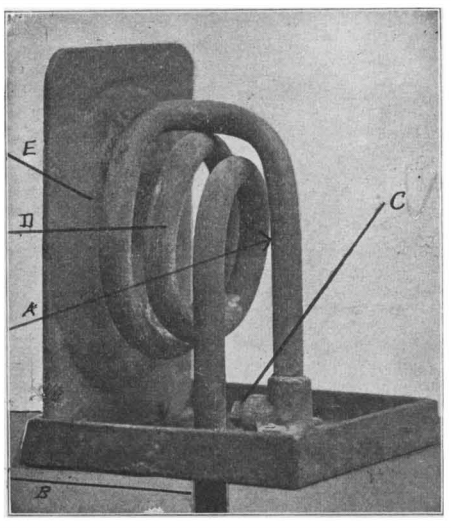

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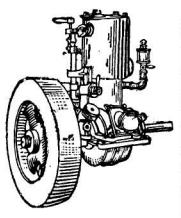

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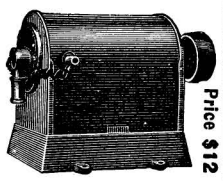

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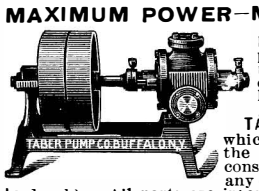

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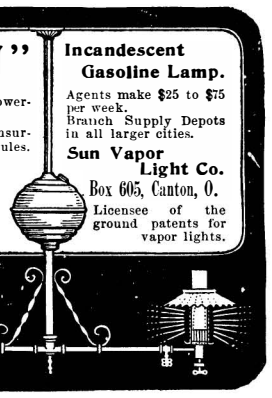

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(Continued on page 282)

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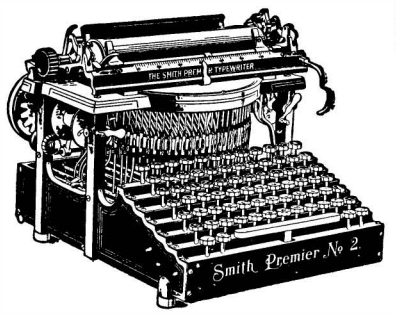

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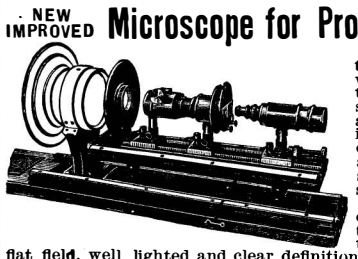

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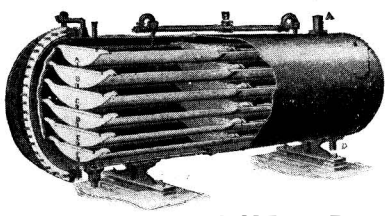

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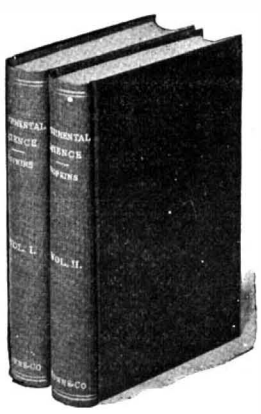

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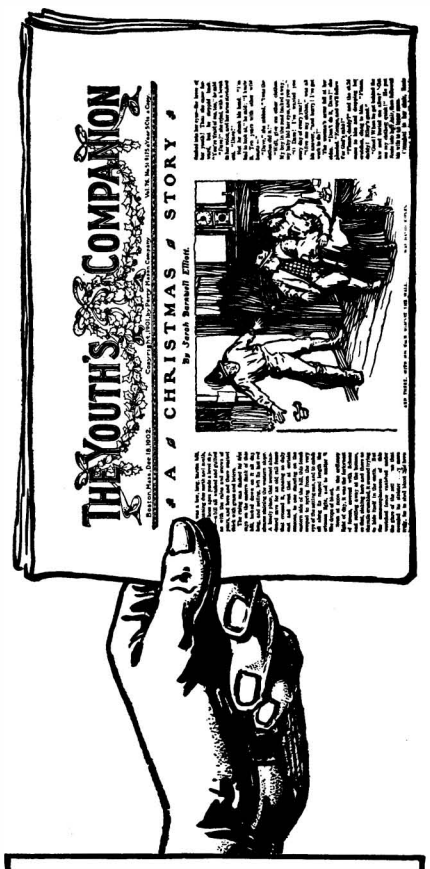

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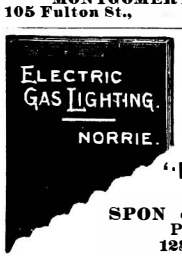

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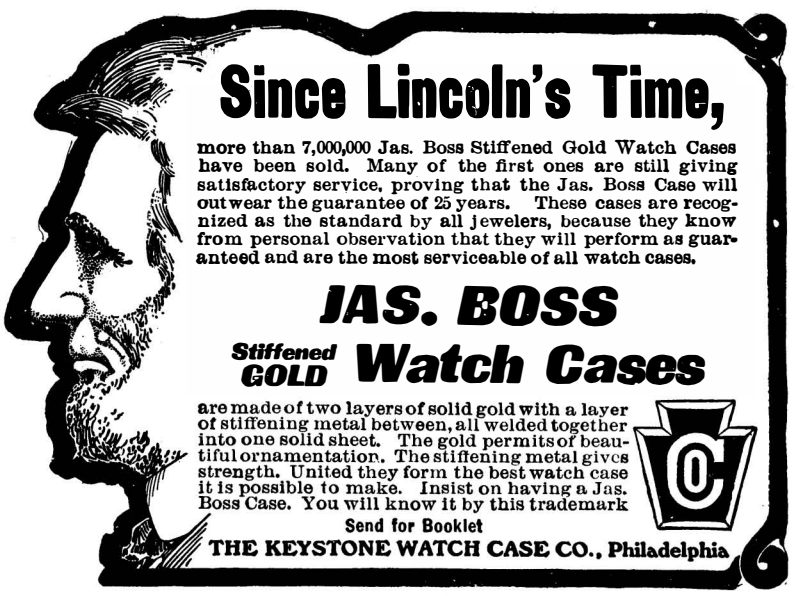

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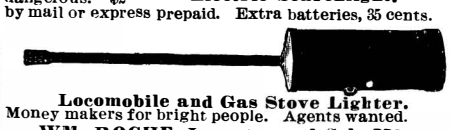

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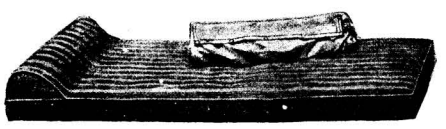

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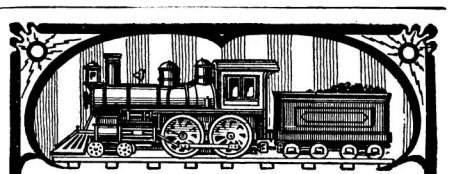

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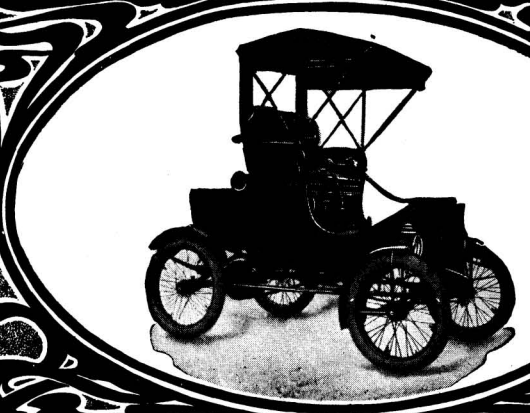

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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

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FOREIGN TRADE REQUIREMENTS. Published annually with quarterly supplements. New York: Lewis, Scribner & Company. 1902. Pp. 532.

Our present industrial expansion renders the publication of a work such as "Foreign Trade Requirements," timely. In order to pass a critical opinion upon the work, it would be necessary to use it some time as a reference book. But a careful examination convinces us that its pages are replete with matter which should be of extreme value to the exporter. The information contained in the book is carefully classified, condensed and arranged in the following sections: Trade Conditions, Traveling Salesmen, Credit Customs, Commercial Law, Trade-Marks and Patents, Patent Laws, Transportation Facilities of the World, Coins and Currencies of the World, Miscellaneous, Cable Rates to all Countries, Weights and Measures of Foreign Countries, and Commercial Cities of the World.

DIAGNOSIS BY MEANS OF THE BLOOD. By Robert Lincoln Watkins, M.D. New York and London: The Physicians Book Publishing Co. 1902. 8vo. Pp. 388. Price $5.

Physicians are apt to look rather askance on examinations of the blood in diagnosing cases. Nevertheless it must be admitted that a work of the character such as Dr. Watkins has written should refute all doubts of the efficacy of blood diagnosis. The system which Dr. Watkins describes is one which he has evolved himself. The work is, therefore, eminently original in its character, and for that reason extremely valuable. So far as we know, no similar work has appeared in medical literature. In order to elucidate his text, the author has introduced a very full series of reproductions from photographs taken by himself.

TRADES WASTE: ITS TREATMENT AND UTILIZATION. By W. Naylor. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Co. 1902. 8vo. Pp. xv, 267. Price $6.50.

This is the first publication of any length which is devoted to the subject of trades waste, as a whole. Although the work bears more the character of a compilation than of original research, it is, nevertheless, of rare merit. The fact that it contains almost everything that is worth knowing on trades waste is in itself sufficient commendation.

LIST OF REFERENCES ON RECIPROCITY. Books, Articles in Periodicals, Congressional Documents. Compiled under the direction of A. P. C. Griffin. Washington: Government Printing Office. 1902. Pp. 38.

THE BADGER PHARMACIST. Published in the interests of pharmacy in Wisconsin. By the students of the School of Pharmacy of the State University, Madison, Wisconsin. 1900. Pp. 292.

COAL, LIGNITE AND ASPHALT ROCKS. Bulletin of the University of Texas. No. 15. Issued semi-monthly. Pp. 138.

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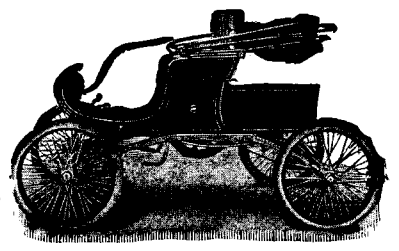

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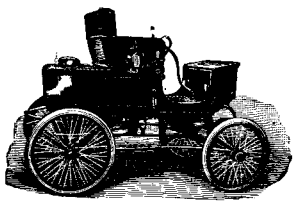

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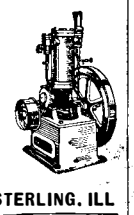

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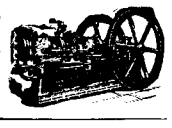

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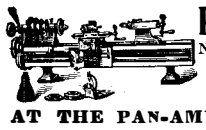

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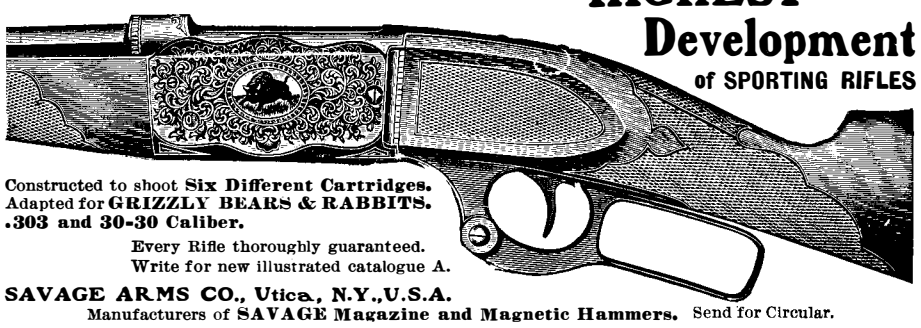

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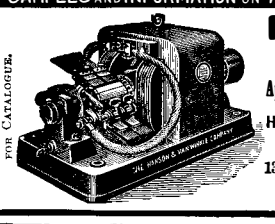

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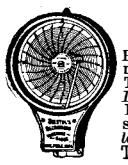

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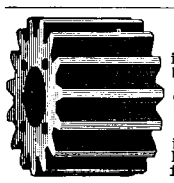

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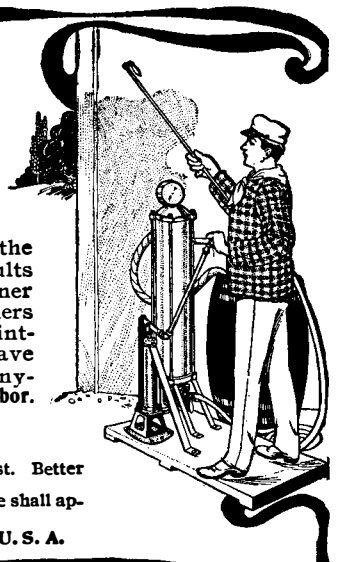

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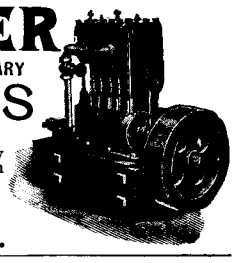

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